

AUSTRALASIAN MOLE-CRICKETS OF THE FAMILY GRYLLOTALPIDAE (ORTHOPTERA)

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Text figs. 1-16.

THE Australasian members of this family have been greatly neglected by recent workers on Orthoptera. The species have not been reviewed previously, and much of the literature dealing with them is scattered in early European works, inaccessible to Australian workers. I am, therefore, much indebted to Messrs. L. Chopard (Paris) and B. Uvarov (British Museum), Professor Dr. A. Reichen-
sperger (Freiburg), and Dr. C. Willemse (Holland) for their courtesy in supplying manuscript copies of papers, sketches, ex-Australian material, etc., and for their notes and comments on types preserved in European museums. For loans of material I tender thanks to Messrs. W. B. Gurney, H. Hacker, F. G. Holdaway, R. Mungomery, A. Musgrave, and A. J. Nicholson, and to Dr. R. J. Tillyard, of New Zealand.

All the known Australasian and one Patagonian species are dealt with, and some observations are made on the life-histories and habits of species of *Gryllotalpa* and *Cylindracheta*.

The types of all but two of the species described as new are in the South Australian Museum. Except where the notation indicates otherwise, the measurements given are to be read as correct to the nearest tenth of a millimetre.

Family GRYLLOTALPIDAE.

The distinguishing features of the family may be briefly summarized as follows: Crickets (mole-crickets, courtilière) of subterranean and aquatic habits, with anterior legs adapted for burrowing. Females with ovipositor obsolete.

The members of the family are, in addition, usually characterized by having a large oval prothorax and powerful forelegs armed with processes, conveniently known as "daetyls." The family is divided into several subfamilies, three of which, being Australasian, are considered here. Although the family is small, the splitting up into such subfamilies is justified because of the great specialization of form and habit which exists.

All the members are water-loving, frequenting light soils and sandy ground wherever there is ready access to moisture. Sandy banks (of creeks, waterholes,

lagoons, etc.) and sandhills are their chief habitats in Australia. Speaking generally, the species found in light soils are clothed in a velvet-like down, whereas those frequenting sand have the clothing sparse or absent.

DISTINGUISHING CHARACTERS OF THE SUBFAMILIES OF GRYLLOTALPIDAE.

- A. Body stout. Antennae composed of many short segments. Compound eyes developed; ocelli two (if present). Anterior tibiae with from two to four daetylar processes. Tarsi three-segmented with paired claws. Anal cerci long and filiform. Elytra, when present, modified for stridulation in both sexes *Gryllotalpinae*
- B. Body elongate, cylindrical, apterous. Antennae seven- to eight-segmented; eyes simple; ocelli absent. Anterior tibiae armed with five daetylar processes, tarsi one- or two-segmented, claws modified or absent; cerci abbreviated *Cylindrachetinae*
- C. Size very small, body slender. Head with antennae short, filiform (composed of ten segments in Australasian species); eyes compound; ocelli three. Anterior legs modified for burrowing; posterior legs greatly adapted for jumping; apex of abdomen furnished with four appendages *Tridactylinae*

Dr. Tillyard (1), in his recently published text-book, has based a diagnosis of the family on his observations of the New Zealand mole-cricket, a specialized form in which the auditory and stridulatory organs are undeveloped; his remarks must therefore be qualified. In most of the species of *Gryllotalpa* the males produce loud stridulating sounds by means of structures developed on the elytra. Sometimes the music is so loud that of one species Roepke (2) has said, "G. hirsuta gehört nämlich zu den lautesten zirpenden Insekten auf Java." The tympani of the ears are situated in the anterior tibiae, and are almost concealed by an overlapping process of the derm, so that only a slit is visible. The tracheae within are very large. A narrow trachea passes up through the femora, and is open to the air by an elongate slit, closed by a hair-margined flap, situated just behind the postero-lateral margin of the pronotum.

It is generally assumed that only male mole-cricket are capable of producing sounds; but an examination of any of the females of the Australian species of *Gryllotalpa* will reveal an apparatus on the under surface of the elytra with which this sex also is capable of making itself heard. An examination of females of the European species, *G. gryllotalpa*, shows that a moderate strigil is similarly developed on the elytra (fig. 4 A). I have observed, on two occasions, females of *G. oya* kept in captivity in a glass-covered vivarium.

(1) Tillyard, B. J., Insects of Australia and New Zealand, 1926, p. 97.

(2) Roepke, W., Treubia, i, 1919, p. 92.

vibrating their elytra and emitting dull, pulsating sounds clearly audible six feet away, and answering the calls of a male confined in another chamber. In stridulating, the elytra, in both sexes, are simultaneously moved laterally in opposite directions. Starting from the position of rest, they are opened until their posterior margins barely overlap, and are then returned rapidly to their former positions.

Sound producing and auditory organs have not been noticed previously in *Cylindracheta*, but nevertheless are well developed. Some members of the Tridaetylinae are apparently mute, but in others well-marked stridulating files are present on the elytra, together with what appears to be a dorsal amplifying or auditory tympanum on the first abdominal segment. These organs also have apparently not been described hitherto.

Several species of the family are of economic importance because of their depredations amongst root crops, and because their burrowings help to destroy the banks of water channels and dykes. Various methods of artificial control have been suggested, but their discussion is outside the province of this paper. The known natural enemies of mole-crickets are not numerous, and have been little used for control work. For the destruction of one species (*Scapteriscus vicinus* Scudder) the Surinam toad (*Bufo aqua*) was recently imported to Porto Rico from Barbados.

Many mole-crickets are attacked by mites (*Neothrombium*), of which several hundreds may be present on the one individual. A nematode worm (*Oxyuris korsakovii* Serg.) has been found parasitizing mole-crickets in Asia, and an undescribed species has been found in Australia.

KEY TO THE GENERA OF GRYLLOTALPINAE.

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| A. Anterior tibiae with two movable and two fixed dactylar processes | <i>Gryllotalpa</i> |
| B. Anterior tibiae with two movable and one fixed process | <i>Triamescaptor</i> |
| C. Anterior tibiae with two movable dactylar processes only | <i>Scapteriscus</i> |

The first-named genus is almost universally distributed; *Scapteriscus* was formerly believed to be confined to the Americas, but one species, *S. leptodactylus* Chopard has just been described from Bengal. *Triamescaptor* is peculiar to New Zealand.

Subfamily Gryllotalpinae.

GRYLLOTALPA Latreille.

Gryllotalpa Latreille, Hist. Nat. Crust., Ins., iii, 1802, p. 275, 1804, p. 121; Scudder, Mem. Peabody Acad. Sci., 1869, p. 6.

Curtilla Oken, Lehrb. Nat., iii, 1815, p. 445; Kirby, Syn. Cat. Orth., ii, 1906, p. 4 (full synonymy).

Australotalpa Mjöberg, Ent. Tidskr. 34, 1912, p. 30 (Type, *A. pluvialis* = *G. nitidata*.)

Type. *Gryllotalpa gryllotalpa* Linn., Europe. The genus *Australotalpa*, as defined, differs from *Gryllotalpa* chiefly in the absence of clothing on the body, and in the arrangement of spines of the posterior tibiae; the discovery of a form intermediate in character destroys what little value it may have had. The type of *Australotalpa* is indeed closer to *G. australis* than the latter is to the *G. africana* group. If sub-generic division is desirable *australis*, *aya*, and *nitidata* may be grouped together under *Australotalpa*.

The frequent absence of the ocelli in apterous and brachypterous forms (but only when the absence of wings is common to both sexes) is worthy of note; in examining a series of several hundred adults of *G. aya* traces of ocelli, usually on one side of the head only, were noted in one or two examples.

The species are generally regarded as very variable. Polymorphism is most marked in *G. africana* and *G. australis*; in the other species, with a more limited distribution, there is little variation except in size.

The genus is known to range in time from the Oligocene of Europe. A male elytron (*Gryllotalpa prima* Cockerell) has been found in the Gurnet Bay deposits of that age in the Isle of Wight; it is unmistakably related to modern forms.

KEY TO THE AUSTRALIAN SPECIES OF GRYLLOTALPA.

- A. Pronotum smooth and shining, with or without sparse clothing.
- a. Pronotum without downy-clothing; elytra well developed, males with wings vestigial, females fully winged; ocelli prominent *nitidata*
 - b. Pronotum sparsely clothed, elytra abbreviated; wings vestigial, ocelli not developed *aya*
- B. Pronotum velvety and dull.
- a. Elytra well developed, ocelli conspicuous.
 - a. Elytra with dark markings; wings in male abbreviated, in female fully developed or vestigial; first segment of posterior tarsi with external apical spur present *australis*
 - b. Elytra uniformly pigmented; wings fully developed in both sexes; first segment of posterior tarsi with external apical spine absent or vestigial.
 1. Posterior tibiae armed with internal marginal spines *africana*
 2. Posterior tibiae unarmed except at apex *pilosipes*
incermis
 - b. Elytra vestigial, wings absent, ocelli vestigial or absent *howensis*

GRYLLOTALPA NITIDULA Serville.

Fig. 1.

Gryllotalpa nitidula Serv., Ins. Orth., 1839, p. 307; D'Orbigny, Dict. d'Hist. Nat., iv, 1849-61, p. 307, Atlas ii, Orth., pl. 3, fig. 4; Scudder, Mem. Peabody Acad. Sci., i, 1869, p. 17; Saussure, Mém. Soc. Genève, xxv, 1877, p. 35. *Austrotalpa pluvialis* Mjöberg, Ent. Tidskr., 34, 1913, p. 30. *Austrotalpa nitidula* Chopard, Ark. f. Zool., 18A, 6, 1925, p. 5.

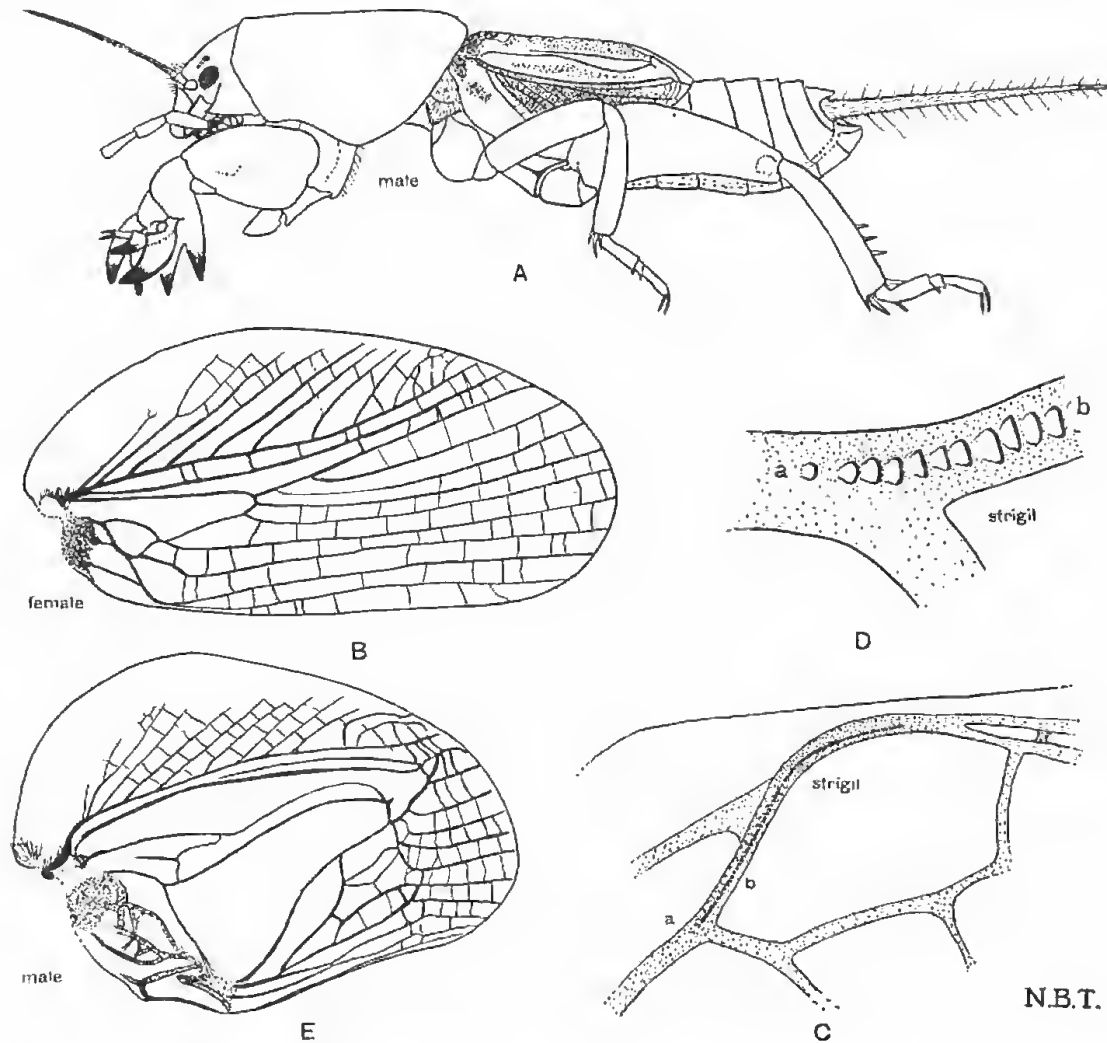


Fig 1. *Gryllotalpa nitidula* Serville. A, adult male $\times 2$; B, elytron, female; C, ditto, portion of underside of anal margin to show strigil; D, ditto, further enlarged; E, elytron, male.

♂ Large, robust, dark reddish-brown. Head broad, smooth, dark reddish-brown, clypeus and labrum pale yellow with darker prominences, the latter covered with coarse reddish hairs; eyes moderate, convex and protruding, black with lighter anterior margin; ocelli small, round, depressed, and very slightly

convex. Pronotum smooth and polished; length-breadth index 73, the anterior margin above lightly concave, antero-lateral margins somewhat abruptly angulate, lateral margins concave, posteriorly well rounded; median longitudinal impression obsolete indicated by somewhat paler colouring. Abdomen dull dark reddish-brown, finely pubescent; cerci stout, longer than pronotum, densely pubescent, long sensory hairs scanty. Elytra reaching beyond hind margin of fifth tergite; greyish and opaque with darker veins and a small basal costal and larger elongate subcostal darker patch. Wings abbreviated (6 mm. in length), normally concealed by elytra. Anterior legs with process of trochanter not densely hairy; lower posterior margin of femora markedly incised at two-thirds; blades of tibiae long, curved, and sharp; first cultrate segment of tarsi with hairy basal area reduced; second and third segments clothed with sparse reddish hairs; claws slender. Median legs with four moderately long tibial spines; apical ventral spines of first and second tarsal segments conspicuous. Posterior legs with tibiae armed with five inner marginal and seven apical (three internal, four external) spines; first tarsal segment with two apical spines, the external one moderate, the internal large. Length, 34 mm.; pronotum, 11.3 mm.; width, 8.2 mm.; elytra, 12.5 mm.; cerci, 15.0 mm.

♀ Similar to male. Pronotum slightly wider in proportion to length (index 75) than in male. Elytra long, covering three-fourths of abdomen, opaque brownish-grey, with veins brown; wings long, extending beyond cerci when in repose. Length, 34 mm.; pronotum, 11 mm.; width, 8.2 mm.; elytra, 12.8 mm.; cerci, 12.0 mm.

Loc. Queensland: Blackall Range, Brisbane, Eidsvold. New South Wales: "Lackey River."

Six examples have been examined; they differ little either in form or colour. The descriptions were drawn up from the examination of a male example from Brisbane and a female from the Blackall Range, the latter from same locality as Mjöberg's examples. There can be no doubt that his species, *Austrotalpa pluvialis*, is the same as *G. nitidula*. Of the type of the latter M. Chopard says: "Le type de Serville, au Muséum de Paris, est en très bon état et m'a permis de constater que les individus rapportés par M. E. Mjöberg ne peuvent en aucune façon en être séparés spécifiquement."

The stridulatory file of the female in this species is confined to a single vein of the elytra. An enlarged sketch ($\times 75$ approx.) shows that the teeth vary in size. They are heavily chitinized on their wearing edges, which are somewhat flattened.

GRYLLOTALPA OYA sp. nov.

Figs. 2 and 3.

♂ Moderate, robust; head, thorax, and abdomen smooth, unicolorous dark chestnut-brown, with legs, except extremities of forepair, lighter. Head broad; clypeus pale yellow with darker prominences, and coarse, scattered reddish hairs; vertex smooth, with fine pubescence; antennae chestnut, the joints of each of the basal segments yellowish; eyes small, prominent, ocelli absent.

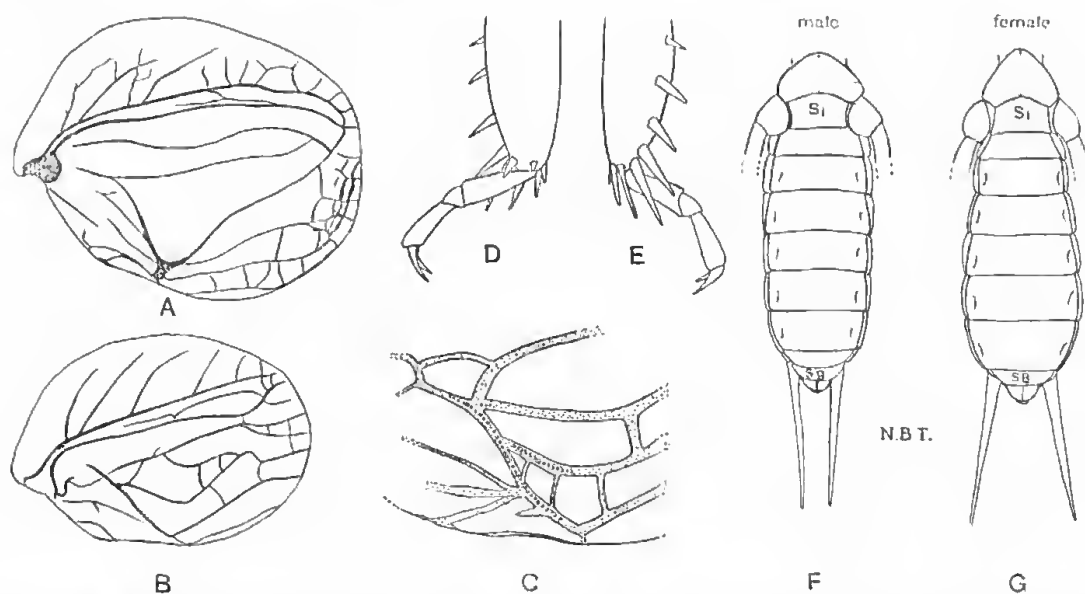


Fig. 2. *Gryllotalpa oya* sp. nov. A, clytron, male; B, ditto, female; C, ditto, underside of anal margin; D, apex of posterior tibia and tarsi, external aspect; E, ditto, internal aspect; F, abdomen of male, from below; G, ditto, female.

Pronotum smooth, polished, clothed with fine hairs, front margin evenly concave, length-breadth index 69; median longitudinal impression shallow, marked by a pale line and median area. Abdomen rather long, somewhat slender at base, dorsal segments polished, but rather densely pilose; cerci shorter than pronotum, stout at base, but slender apically, clothed with fine pubescence and long sensory hairs. Anterior legs with tibiae stout, daetyls robust, curved, polished; first cultrate segment of tarsi dark castaneous, highly polished, the basal third densely hairy; claws long and slender. Posterior legs with tibiae armed with an inconstant number of spines (three internal marginal and three internal and three external apical ones are present on the type). Elytra shorter than pronotum, greyish-brown, opaque with veins dark-brown; venational pattern as in fig. 2 A. Wings absent, except as vestigial buds less than 1 mm. in length. Length, 30 mm.; of pronotum, 9.4 mm.; breadth, 6.5 mm.; cerci, 9.0 mm.; elytra, 5.8 mm.

♀ Similar to male, somewhat larger, abdomen longer; cerci shorter. Elytra somewhat smaller, venation variable (figs. 2 B and 3 G). Length, 31 mm.; pronotum, 9.5 mm.; breadth, 6.7 mm.; cerci, 7.1 mm.; elytra, 4.5 mm.

Loc. South Australia: Glenelg (A. G. Edquist and N. B. Tindale), Henley Beach (J. C. Reid and N. B. Tindale), Port Elliott, Kangaroo Island (A. M. Lea). Type, a male, allotype female, and many paratypes, 1. 14910, in South Australian Museum.

The name chosen for this species is derived from the aboriginal name (Kaurna or Adelaide tribe) for species of the family. Crickets generally, including probably this species, formed items in the food supply of the natives.

Life history. The egg and first instar larva are unknown. Second instar larvae are about 6 mm. in length (pronotum 2.0–2.5 mm.), very pale brown in colour, with the tips of the anterior tibial dactyls, process of trochanter, and mandibles, chestnut-brown, with darker apices. The dactyls of front tibiae are long and stout, the basal one being rather conspicuous (not, as in *G. africana*, much reduced). The posterior tibiae lack internal marginal spines. (Fig. 3 A.)

Third instar larvae are from 7 to 9 mm. in length (pronotum 3.0–3.5 mm.). The chitinous parts are much tougher, but they are similar in colour to larvae of the second instar (fig. 3 B). Small spines are sometimes present on the inner margins of posterior tibiae.

Fourth instar larvae range from 10 to 14 mm. in length (pronotum 3.7–5.0 mm.). They are darker in colour, and the front tibiae are stouter and acutely pointed. Usually one (sometimes two or more) internal marginal spines are present on the posterior tibiae. Elytral buds are not apparent externally. (Fig. 3 C.)

The fifth instar examples vary from 16 to 20 mm. in length (pronotum 5.3–7.0 mm.). Elytral buds are visible, and three or four internal marginal spines are present on the posterior tibiae. (Fig. 3 D.)

In the antepenultimate stage the larvae vary from 22 to 26 mm. in length (pronotum 7.0–8.3 mm.). The elytral buds are well developed (1.1 mm. in length), and there are usually four marginal spines on the posterior tibiae. (Fig. 3 E.)

The adults are a much darker brown than the larvae, the pronotum is usually no longer, but the abdomen of the female is more elongated, owing to the development of the eggs within her body.

Adults and larvae live principally in sand on or near the sea-beach. After showers have moistened the surface of the sandhills their lines of progress just beneath the ground are marked by broken tracks on the surface, and single individuals can be generally secured by digging along these indications. The type examples, together with many others, were taken in this manner. The

winding tracks were measured; the longest noticed extended for 42 feet, and it was evident that the whole distance had been traversed since rain had fallen the previous night; usually, however, the tracks were much shorter.

On being disturbed these mole-crickets eject, with considerable force, a quantity of clear mucilaginous liquid from a gland at the anal extremity of the abdomen. This liquid can be projected to a distance of at least 23 cm. (9¼ inches).

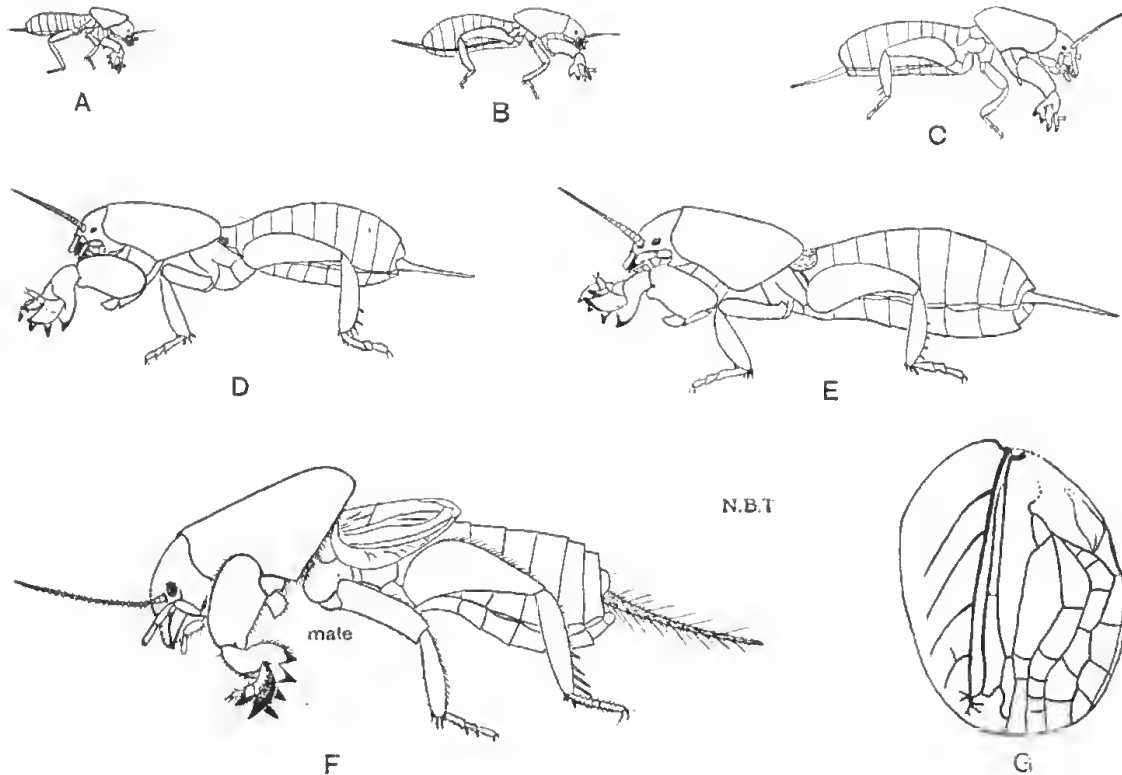


Fig. 3. *Gryllotalpa oya* sp. nov. A, larva, 2nd instar, $\times 3$; B, ditto, 3rd instar; C, ditto, 4th instar; D, ditto, 5th instar; E, 6th instar; F, adult male; G, female elytron.

Their omnivorous habits were first brought to my notice by Mr. J. C. Reid, a carnation grower of Henley Beach, who had suffered a loss of prize seedlings through their attacks. The crickets not only disturbed the root systems by burrowing in the surface, sandy soil, but were observed gnawing through the succulent stems at ground level. On digging up the seedbeds in April, 1926, many hundreds were obtained, in all stages except the first larval one. The burrows of the adults were traced to a depth of three feet; most of the larvae, however, were taken just below the surface. All females secured were barren, and no eggs or egg chambers were apparently present in the seed-beds at that time. Of a hundred adult examples selected at random 62 were males and 38 were females.

GRYLLOTOTALPA AUSTRALIS ERICHSON.

Gryllootalpa australis Erichson, Arch. f. Naturg., viii, 1842, p. 249; Scudder, Mem. Peabody Acad. Sci., 1869, p. 16, pl. i, figs. 5, 16, 24, 25; Saussure, Mém. Soc. Genève, xxv, 1877, p. 33.

♂ Head, dorsal surface of abdomen, and parts of elytra, dark brownish-black, ventral surface of abdomen, pronotum, posterior legs, antennae, and cerci dull brown, anterior and median legs reddish-brown. Head moderate, rounded, vertex clothed with fine yellowish pubescence, clypeus whitish with prominences and upper margin dark brown; labrum constricted above, brown, with moderately thick reddish-brown bristles; eyes small, oval, black with white anterior margin, ocelli small, round, and slightly convex, distant the lesser diameter of an eye from the eye itself. Pronotum large, constricted in front, normally velutinous, the median impression moderate, marked by a reddish-brown line from anterior to posterior borders. Abdomen brownish-black, covered with fine ochreous pubescence; cerci as long as pronotum, clothed with long pubescence and many fine sensory hairs. Anterior legs with femora not markedly excised on lower external edge; process of trochanter small and blunt; tibiae much as in *G. africana* but dactyls more strongly curved; first segment of tarsi slender, cultrate blade smaller than in *G. africana*; the second segment short and rather stout; claws sharp, moderately long. Median legs with tibiae armed with four long spines; first and second tarsal segments each with a ventral apical spine. Posterior legs with inner margin of tibiae bordered with four graduated spines, apex internally with three very long spines, externally with four shorter ones; first tarsal joint with two well-developed slender apical spines; the internal one longer than the external one; claws long and slender, two-thirds length of third tarsal joint, the inner claw somewhat longer than the external one. Elytra as long as head and thorax combined, opaque, greyish-brown, with a costal spot, a subcostal elongate triangular mark extending from base to near apex and a broad basal suffusion brownish-black, veins dark brown. Wings abbreviated, nearly as long as, but concealed by, elytra. Length, 25 mm., elytra, 8 mm.; pronotum, 7.6 mm.; breadth of pronotum, 5.8 mm.

♀ Similar in colour to male, somewhat larger in size. Elytra long, with veins of posterior half conspicuously parallel, almost wholly dark brown or brownish-black with darker veins, a narrow costal and apical area greyish. Length, 32 mm.; elytra, 13 mm.; pronotum, 9.0 mm.; breadth of pronotum, 7.0 mm.

Loc. Tasmania: Hobart. Victoria: Healesville, Black Spur, Narbethong, Indi. South Australia: Mount Gambier, Lucindale, Blakiston, Mount Lofty, Blackwood, Lyndoch, Kangaroo Island. New South Wales: Mount Victoria,

Sydney, Bago Forest, Narara, Dorrigo. Queensland: Mount Tambourine. Papua: Mount Yule.

Fifty-five examples have been examined from the above-named localities. One female was taken by Mr. E. Ashby at Blackwood, flying about on a thundery night in March. One example (a fourth instar larva) is exceptional in having on the left side only three dactyls to the anterior tibia (the posterior immovable dactyl being absent). This condition is usually found only in the first instar larva of *Gryllotalpa*, but is characteristic of the adult of the New Zealand genus *Triamescaptor*, described below. The right tibia on this abnormal individual is as in fourth instar larvae and adults. A first instar larva (probably of this species) from Howlong, N.S.W., has only three dactyls on the anterior tibiae.

The type locality for the species is Woolnorth, Tasmania; a typical male from Hobart has been examined for the purposes of the above description; mainland examples are larger. In occasional adult examples the velutinous clothing is unusually sparse, and the surface of the pronotum appears much as in the preceding species. In using the key a little difficulty may therefore occur with old and abraded examples.

In the vicinity of Sydney a dwarfed, wingless form is found, as well as the typical one; this may be distinguished by a varietal name.

GRYLLOTALPA AUSTRALIS VAR. *BRACHYPTERA* VAR. NOV.

♀ Similar to typical *G. australis* but smaller. Ocelli present but very small; elytra shorter than pronotum, wings entirely absent. Length, 21 mm.; pronotum, 7.0 mm.; width, 5.5 mm.; elytra, 5.2 mm.

Loc. New South Wales: Sydney, Campbelltown. Type, I. 14911, in South Australian Museum; paratype, K. 3338, in Australian Museum.

The presence of ocelli and the velutinous clothing distinguish this variety from *G. oya*, the only species with which it is likely to be confused.

GRYLLOTALPA AFRICANA Palisot de Beauv.

Fig. 4.

Gryllotalpa africana Pal. de Beauv., Ins. Afr. Amér., 1805, p. 229, pl. 2c, fig. 6; Serville, Ins. Orth., 1839, p. 307; Scudder, Mem. Peabody Acad. Sci., 1869, p. 20, pl. i, figs. 10, 26, 27; Saussure, Mém. Soc. Genève, xxv, 1877, p. 31; Roepke, Trenbia, i, 1919, pp. 90-97, pl. vii.

G. orientalis Burmeister, Handb. Ent., ii, 1839, p. 739.

G. coarctata Walker, Cat. Derm. Salt. B.M., i, 1869, p. 6; Sauss., *l.c.*, p. 32; Froggatt, Agric. Gaz., N.S. Wales, xvi, 1905, p. 479, fig. 2.

♂ Dingy yellowish-brown, slightly darker above. Head dark brown, antennae yellow, eyes black, ocelli large, obovate, and somewhat globose, situated

a distance of about the least diameter of an ocellus away from eyes. Pronotum velutinous, front margin evenly concave (fig. 4 C, D); a characteristic median band conspicuously impressed. Lower external margin of front femora slightly excised anteriorly; tibial dactyls moderately long; first tarsal caltrate segment with only the basal third densely hairy (fig. 4 E), second about one-third the size of first, third twice as long as wide, claws moderately long. Posterior tibiae with four posterior internal marginal and seven apical (4 external, 3 internal) spines. First segment of tarsi with an internal apical spine, sometimes also vestiges of an external spine. Elytra more than half length of abdomen, hyaline, only slightly pigmented at base. Wings in repose, filamentous, reaching to tips of anal cerci (in the typical form). Abdomen dark brown, apex above furnished with lateral rows of rusty hairs. Length, 29 mm.; pronotum, 8.5 mm.; breadth, 7.0 mm.; elytra, 13 mm.

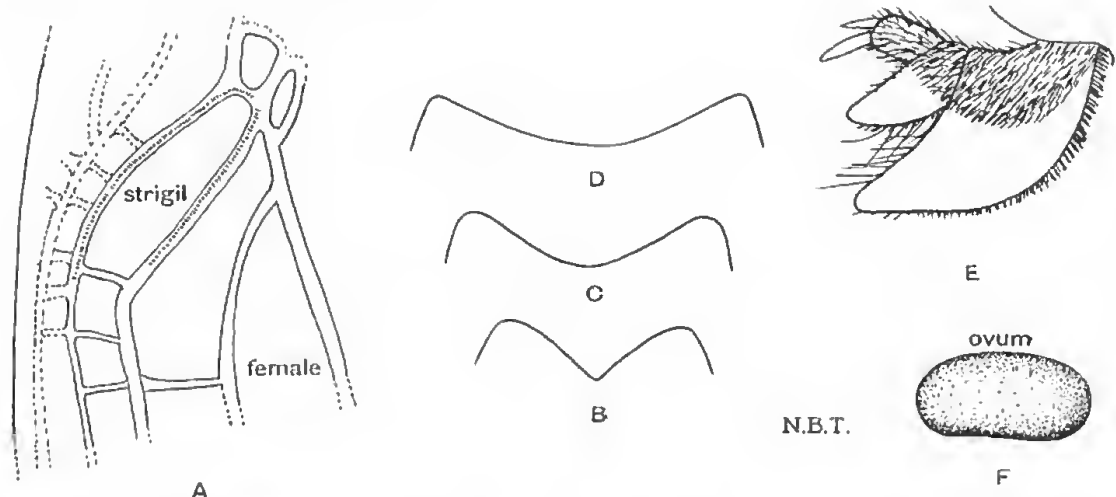


Fig 4. *Gryllotalpa gryllotalpa* Linnaeus. A, portion of underside of anal margin of elytron to show strigil. *Gryllotalpa pilosipes* sp. nov. B, outline of anterior margin of pronotum. *Gryllotalpa africana* Palisot de Beauv. C, outline of anterior margin of pronotum, female, Beverley, W.A.; D, ditto, Adelaide; E, anterior tarsus, external aspect; F, ovum, Adelaide, $\times 6$.

♀ Similar to male, ocelli sometimes smaller, wings less modified for stridulation. Length, 30 mm.; pronotum, 8.2 mm.; breadth, 6.6 mm.; elytra, 12 mm.

The above descriptions were drawn up from Adelaide specimens, and Indian and African examples have been used for comparison. Brachypterous examples (in which wings do not reach apex of abdomen) occur sporadically, at Adelaide, Wallacia, Sydney, and Beverley. A series of seven, taken at various times along the Cooper Creek between Innamineka and Lake Eyre, are all brachypterous. Roepke⁽³⁾ records similar examples from Java; he has shown

(3) Roepke, W., Treubia, i, 1919, p. 93.

that the proportion of long- to short-winged examples varies from locality to locality and according to sex. *G. coarctata* Walk. appears to be indistinguishable from *G. africana*. I have examined many specimens identified as *coarctata* by previous workers and cannot find differences. It has been generally assumed that the species from the interior of Australia (*e.g.*, the Horn Expedition material) is *G. coarctata*, but a re-examination shows they are not distinct from *G. africana*.

Loc. Natal: Durban. India: Western Ghats. Java: Buitenzorg. Papua: Mediri, Kaitaki, and Fairfax Island (Fly River). Louisiade Archipelago: Misima. Solomon Islands: Ysabel. New Ireland. Queensland: Saibai Island, Thursday Island, Kuranda, Mackay, Yeppoon, Gladstone, Bundaberg, Brisbane. New South Wales: Upper Williams River, Woodford, Wallacia, Sydney, Port Hacking. Victoria. South Australia: Adelaide, Brighton, Murray Bridge, Monash, Mount Bryan, Goolwa, Renmark, Gawler, Virginia, Reynella, Mount Lofty, Lyndoch, Terowie, Leigh Creek, Cooper Creek, Hergott Springs (now called Marree), Innamincka. Central Australia: Oodnadatta, Pulu Creek, Gosse Range, Darwent Creek, Ellery Creek, Alice Springs. Western Australia: Cunderdin, Beverley, Roeburne. North Australia: Tennant Creek, Darwin, Groote Eylandt.

The species has also been recorded from some islands of the Pacific, including the Hawaiian Islands (Oahu and Kanai), the Philippine Islands, and Formosa. It is widespread in the tropical and subtropical regions of the Old World.

Life history. From observations made on the banks of the Nepean River, New South Wales, and the examination of series in all stages, selected from a mass of over 5,000 examples taken in a couch grass lawn at Brighton, the following details of the life history are apparent:

The eggs are ovate (2.8 x 1.6 mm.), smooth, and brown in colour (fig. 4 F). The newly-hatched larvae are 4 mm. in length; dark greyish-brown in colour, with a pale median line on pronotum and darkly pigmented hind femora. The front tibiae possess only three dactyls, two movable and one (the lower) immovable; only the apical spines are developed on the hind femora. The eyes are comparatively large, and the ocelli are absent. The larvae are active; when washed out of the river bank they swim rapidly and burrow into the sand at the water's edge with ease.

At the end of the first instar the larvae are much swollen, 6 mm. in length, with the dark part of the abdominal segments alternating with nearly equal widths of lighter chitin, giving the abdomen a conspicuous banded appearance.

The larvae of the second instar are from 6 mm. to 9 mm. in length, light brown in colour, and very active. A second small immovable dactyl is developed

on the front tibiae, the posterior tibiae possess two or more marginal spines, and the ocelli are either absent or but slightly indicated.

In the third instar the larvae are 10 mm. to 13 mm. in length. The second immovable dactyl of the front tibiae is larger and the marginal spines on the posterior tibiae number four or five. The ocelli are usually only just visible.

The larvae of the fourth instar are from 12 mm. to 18 mm. in length. They resemble closely in structure the larvae of the preceding stage, but small swellings on the meso- and meta-thorax indicate the budding wings. The ocelli are noticeable but small. The abdomen has a multifaculate appearance, due to the development of three light patches on each segment; the legs are usually lighter in colour than the body, and the tibial dactyls are dark brown.

The spotted appearance of the abdomen is also present in the fifth instar. The size increases from 18 mm. to 26 mm. The elytral buds are nearly 2 mm. in length and the wing-buds 3 mm. The ocelli are frequently well developed, but in some examples are either small or apparently absent.

An example undergoing the change to the 6th instar shows that the old skin breaks first along the middle line of the pronotum, and may be cast in several pieces. After the ecdysis the larva is light honey-coloured, but becomes rapidly darker. There is some increase in size (or variation) in this instar, and examples measure from 26 mm. to 32 mm. in length, the females being usually larger than the males. The elytral buds are 4 mm. in length and the wings 7 mm. In this and the preceding stage (as in the adult) the sexes can be distinguished by the difference in the numbers of *visible* ventral segments of the abdomen (the male has apparently one more than the female). The ocelli are well developed. All the larval examples described above were taken at Brighton, S.A.; but similar series were also collected at Port Hacking and at Wallacia, New South Wales.

Adults vary from 26 mm. to 33 mm. in length. The female lays her eggs in masses in an oval chamber amongst roots near water's edge. The chamber is of compacted earth or sand, and is two inches long. Eggs dissected from the abdomen vary from light to dark brown in colour, the latter being ready for deposition. The sexes are probably present in about equal numbers. In a hundred examples from Brighton, selected at random from a mass of adults, 54 were found to be females and 46 males. Of the females 51 had deposited their eggs or were barren, and of the remaining three, one contained 36, another 14, and a third only 7 eggs. Miss Brewster (¹), who examined, and recorded (under the name of *G. couretata*) two egg-chambers she found near Sydney, says that each contained about 200 eggs.

(¹) Brewster, M. N., Australian Naturalist, iii, 1916, p. 111.

Little is known regarding the duration of the life-cycle. Burakova (5), who has studied the life history of *G. gryllotalpa*, states that in Novgorod the life-cycle is completed in from two to two and a half years.

Thomas (6) states that the life history of *Scapterisus vicinus* Latr. of Porto Rica is completed in about eight months.

The adults live in galleries underground, usually in sandy soil near water. They are omnivorous, burrowing amongst the roots of plants to obtain earth-worms and insects, and attacking the roots and bases of the stems of seedlings and vegetables. In Africa, Southern Asia, Java, Formosa, and Hawaii this species has been recorded as injuring coffee, cacao, rice, sorghum, opium-poppy, pawpaw, and rhubarb. In Queensland and Hawaii they have been known to injure maize and sugar-cane, the root bands of the latter crop being gnawed, the "eyes," eaten out, and holes made into the interior of the canes. Lawns are frequently injured in the southern parts of our continent, and at Virginia (7), in South Australia, wheat crops have been seriously attacked.

At Virginia the mole-crickets follow the tracks of the drill and gather up germinating wheat, storing it in circular chambers some six inches or a foot underground, together with the seeds of clovers (*Medicago* and *Trifolium*). They work with such energy that they sometimes remove every grain of wheat from areas several square yards in extent. It is of interest to note that the acquisitive habits of mole-crickets were formerly denied. As early as 1832 Gray (8) said: "Another kind of foresight has also been attributed to these animals [*G. gryllotalpa*]; some will have it, that equally with the *ants*, they transport into their asylums, like the latter, grains of corn, alimentary substances, etc. But for what purpose should they employ such useless care and pains?"

An examination of the stomach contents of several specimens of *G. africana* gave the following results: A sixth instar female larva from Virginia contained vegetable cells, starch, small oil globules, and many small transparent crystals. An adult female from Henley Beach contained large fragments of vegetable tissue, chitinous fragments of an adult, and portions of one or more immature mole-crickets. Another from the same locality contained much vegetable matter and many spines of a fairly large spider.

Adults kept under observation in a vivarium lived for three months on a mixed diet of germinating wheat, trefoil-seed, and dead blowflies. Cannibalism

(5) Burakova, L. V., Rev. russe Ent., xix, 1925, pp. 139-142 [In Russian].

(6) Thomas, W. A., United States Agricultural Dept., Farmers' Bulletin, No. 1561, 1928, pp. 1-8.

(7) Lea, A. M., Proc. Roy. Soc. South Australia, 1925, p. 302.

(8) Gray, Griffith, Animal Kingdom, xv, 1832, p. 194.

was in evidence, and several larvae succumbed to the attacks of mature specimens. They were most active after 4 p.m., and stridulating calls were frequently noticed after that hour.

GRYLLOTALPA INERMIS Chopard.

Chopard, Ann. Soc. ent. France, xciv, 1925, p. 30.

♀ "Taille et forme de *G. africana*. Tête brune, front arrondi, les ocellles gros. Pronotum roux clair, fortement rétréci en avant, avec une impression médiane et une ligne transversale déprimée au quart antérieur; bord antérieur très concave.

"Pattes roux clair. Femmes antérieurs à bords supérieur et inférieur presque droit, à peu près exactement parallèles; processus du trochanter de même forme que chez *africana*, mais un peu plus long; griffes du tarse extrêmement courtes. Tibias intermédiaires épais et courts, à éperons apicaux assez courts. Tibias postérieurs à bords supérieurs inermes, présentant à l'apex 2 éperons, externes, très courtes, et 3 internes dont l'inférieur presque égal à l'inférieur externe, les deux autres un peu plus longs; tarses comprimés, assez courts.

"Élytres et ailes comme chez *africana*; veine médiastine présentant 8 à 9 branches épaisses, parallèles; champ dorsal à nervures presque longitudinales et assez régulièrement espacées; veicules formant une réticulation rectangulaire également assez régulière.

"Long. 23 mm.; pronot. 7.5 mm.; élytres, 12 mm.; fém. post. 6.5 mm." (Chopard, *l.c.*)

The unique type of this species (which I have not seen) is said to be from Victoria. It differs from the following in the lesser number of apical spines of the posterior tibiae.

GRYLLOTALPA PILOSIPES sp. nov.

Figs. 4 B and 5 A-E.

♂ Resembles small *G. africana* examples. Head smaller and laterally compressed, dark brown, eyes large and prominent, blackish, ocelli oval, very conspicuous. Pronotum light brown, velutinous, narrow at the front margin, which is deeply sub-angulately concave (fig. 4 B). Anterior legs with femora and process of trochanter nearly as in *G. africana*, the latter somewhat longer; tibiae with dactyls short, stout, and blunt-pointed; tarsi projecting beyond tibial dactyls, first segment large, truncate, basal hairy portion greater, smooth apical portion less than in *G. africana* (compare figures); second joint small; third twice as long as wide, claws short and blunt. Posterior legs with tibiae without internal marginal spines, six apical ones present, three internal, moderately long, and three external, much reduced; apical internal spine of first tarsal

joint vestigial, claws moderate. Elytra with venation similar to *G. africana* (fig. 5 B). Wings long, when folded reaching to beyond apex of cerei. Length, 24 mm.; pronotum, 7.3 mm.; elytra, 11.7 mm.

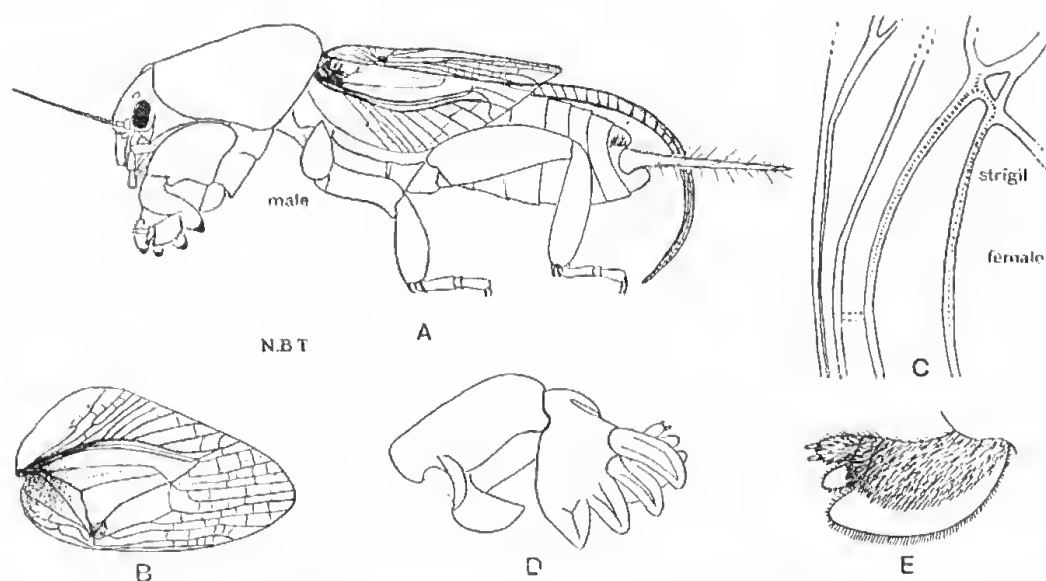


Fig. 5. *Gryllotalpa pilosipes* sp. nov. A, adult male; B, elytron, male; C, elytral strigil in female; D, left anterior leg, internal aspect; E, anterior tarsus, external aspect.

♀ Similar to male. Elytral venation close to that of female *G. africana*. Length, 25 mm.; pronotum, 7.2 mm.; elytra, 11.3 mm.

Loc. North-west Australia: Derby (W. D. Dodd).

Type, a male, and allotype female, 1. 14907, in South Australian Museum.

In the description of *G. inermis* no mention is made of the form and clothing of the anterior tibiae; the present species agrees closely, except that the posterior tibiae are differently armed. Further material will possibly show that both are local races of the widespread *G. africana*, and that there are other races, perhaps not so well defined, to be found in various parts of Australasia (for example, the dwarfed brachypterous form of *G. africana* from Cooper Creek).

A portion of the under-surface of the anal part of an elytron of the female is shown in fig. 5 C to illustrate the inverted U-like development of the series of stridulatory teeth in this species. The file is much reduced in the female of *G. africana*, only the teeth on the outer vein being developed.

GRYLLOTALPA HOWENSIS sp. nov.

Fig. 6.

♂ Short, stout, unicolorous light brown; tips of tibial dactyls and clypeus darker. Head robust, vertex prominent, eyes moderate, black, ocelli vestigial

or absent. Pronotum large, length width index 72; median longitudinal impression slight. Abdomen short, stout, cerci somewhat longer than pronotum. Front legs with tibial dactyls long, curved, sharp-pointed, tips polished and black; tarsi with first eultrate joint long, slender, blade smooth and black, second joint hairy, except tip, third joint slender, claws long and sharp-pointed. Posterior legs with tibiae armed with three long internal marginal and seven apical spines, the external three small, the internal four larger; first joint of tarsus with conspicuous apical internal tooth, claws very long and slender. Elytra short, only nine stridulatory teeth present, of which three are heavily chitinized, wings absent. Length, 26 mm.; pronotum, 11 mm.; elytra, 1.9 mm.

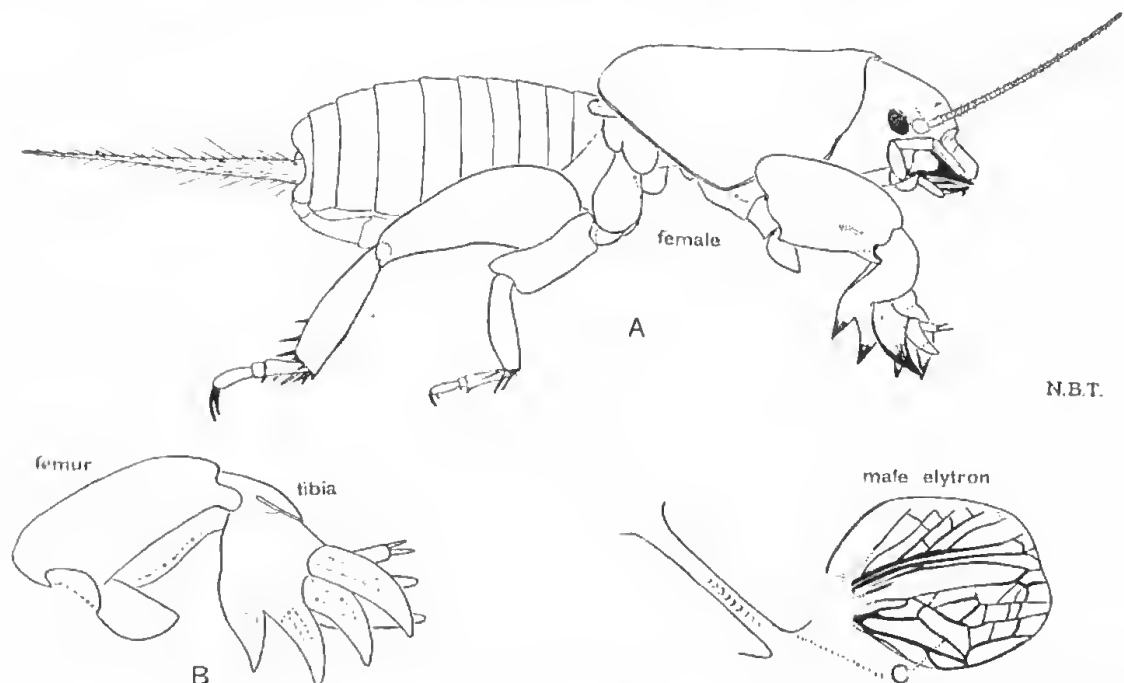


Fig. 6. *Gryllotalpa howensis* sp. nov. A, adult female; B, left anterior leg, internal aspect; C, male elytron, portion enlarged to show small strigil.

♀ Similar to male. Ocelli vestigial, elytra very abbreviated, wings absent. Length, 31 mm.; pronotum, 11 mm.; elytra, 1.1 mm.

Loc. Lord Howe Island (A. M. Lea, December, 1915, to January, 1916, and A. Musgrave, December, 1921).

Type, male, allotype female, I. 14909, and paratypes, in South Australian Museum; paratypes (K. 45687 and K. 55949) in Australian Museum.

Four of the six examples under review are immature, one being a larva of about the fourth instar, and three other nearly mature; all lack ocelli. *G. howensis* is not very closely allied to any other described species.

In both the adult examples ocelli are slightly developed only on the right side

of the head. Stridulation in the male is effected by rubbing the short elytral file (fig. 6 C) against a chitinous protuberance on the metanotum, which is absent or not especially chitinized in some other winged species. The elytra of the females are so reduced that the crickets are probably incapable of producing sounds with their aid.

TRIAMESCAPTOR gen. nov.

Apterous mole-crickets with compound eyes, but without ocelli. Anterior tibiae armed with three dactyls; external indications of tibial auditory apparatus obsolete; cultrate blade of first segment of tarsus reduced.

Type: *Triamescaptor aotea*, New Zealand.

Closely allied to *Gryllotalpa*, of which some authors may regard it as a subgenus. The absence of wings and the three-digitate anterior tibiae are characters of the first instar larva of *Gryllotalpa*. Two views may be put forward with regard to the origin of this genus. We may either regard it as an insular specialization of the world-wide genus *Gryllotalpa*, or as a primitive type with less efficient tibial armature which has been preserved through isolation, and has lost the power of flight in its insular home. Its relationship with species of *Gryllotalpa* is with the purely southern Australian forms such as *G. oya* and *G. australis*, rather than with the widely distributed members of the *G. africana* group.

There are no traces of stridulatory apparatus, and in harmony with its absence the auditory organ on the anterior tibia is absent or vestigial.

Scapteriscus, the American and Eastern Asiatic genus, is separated from *Gryllotalpa* by the absence of both of the fixed dactyls of the tibiae; the present genus is therefore, in regard to this one character, intermediate.

TRIAMESCAPTOR AOTEA sp. nov.

Fig. 7.

♂ Of moderate size; head, abdomen, and posterior femora dark brown; thorax and legs ochreous-brown. Head narrow, triangular, vertex prominent, rounded; labrum convex, rounded, clothed with sparse reddish hairs; clypeus transverse; eyes small, convex, amygdaloid in form; ocelli absent; antennae with basal segment large, longer than second and third combined. Prothorax elongate (length-breadth index 65), ovoid, dull-polished, partly clothed with fine pubescence; anterior margin above concave. Abdomen dark brown, polished, clothed with sparse reddish hairs; cerci longer than pronotum. Anterior legs with femora stout; process of trochanter small, semicircular; tibiae armed with three sharp, stout dactyls, two movable and one fixed; auditory suture obsolete; first segment of tarsi with cultrate blade elongated and slender, second segment

short with cultrate portion moderate, third segment twice as long as wide with long, unequal claws. Median legs with tibiae armed at apex with four long spines; first segment of tarsus as long as second and third combined, first and second ones armed at apex, beneath, with a single spine; claws small. Posterior legs with tibiae armed with ten spines; three of which are on internal margin, and seven apical; of the latter four long ones are on internal margin and three short ones on external margin; two of the latter are subapical and placed widely apart; tarsi with first and second segments unarmed, third segment moderate with stout claws. Length, 26 mm.; pronotum, 9.5 mm.; breadth, 6.2 mm.

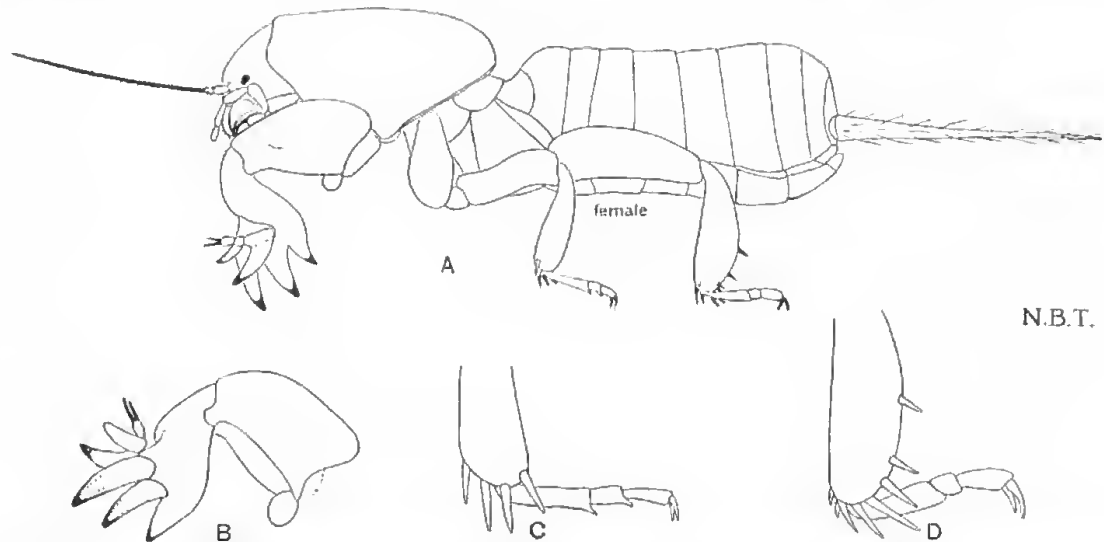


Fig. 7. *Triamescaptor aolca* sp. nov. A, adult female; B, right anterior leg, internal aspect; C, apex of median tibia and tarsus, internal aspect; D, apex of posterior tibia and tarsus, internal aspect.

♀ Similar to male. Pronotum slightly more elongate (index 63). Length, 26 mm.; pronotum, 9.9 mm.; breadth, 6.2 mm.; antennae, 10 mm.; cerci, 12 mm.

Loc. New Zealand: Aramoho, on the Wanganui River, August, 1915; two examples. Type, a male, in Cawthron Institute; allotype I. 14914, in South Australian Museum.

For the opportunity of examining these examples I am indebted to Dr. R. J. Tillyard, who has supplied the following note: "These insects are not generally common throughout New Zealand, and appear to be mostly confined to the North Island, where they have been reported as doing a considerable amount of damage, especially in Wanganui and the surrounding district."

Subfamily Cylindrachetinae.

Giglio-Tos (⁹) has erected the family Cylindrachetidae for the highly

(⁹) Giglio-Tos, E., *Ann. Mus. Civ. Nat. Genova*, xlvii, 1914, pp. 81-101, pl. 1, figs. 1-11.

specialized mole-crickets of this subfamily, but their ancestral relationship with the Gryllotalpinae is probably better expressed by giving them the lower rank.

The distribution of these insects is remarkable, embracing Australasia and southern South America. They are almost blind, apterous, sand-burrowers, whose presence over the whole of the arid parts of Australia, in New Guinea, Melville Island, and the Andes of northern Patagonia, adds to the lengthening list of peculiar families, genera, and species, of animals and plants, which have a southern circum-polar distribution, and are peculiar to these far-sundered regions. One explanation for this type of distribution is the much-discussed Wegener hypothesis of continental drift, which suggests a former contiguity of the southern land masses.

KEY TO GENERA OF CYLINDRACHETINAE.

- A. Mesothorax of large dimensions, closely fused with prothorax. Antennae usually seven-segmented in both sexes. . . *Cylindracheta*.
- B. Mesothorax of small dimensions, divided from prothorax by a constriction, which permits entire freedom of movement between them. Males with seven- females with eight-segmented antennae (after Giglio-Tos) *Cylindroryctes*

The antennae of one species of *Cylindracheta* were described (possibly in error) as being eleven-segmented, and in the type of a second species (also known only from a single example) the antennae were broken off.

Subfamily Cylindrachetinae.

CYLINDRACHETA Gray.

Cylindrodes Gray, Griffiths, Animal Kingdom, xv, 1832, p. 785; Mag. Nat. Hist. (2), i, 1837, p. 141; Brullé, Hist. Nat. Ins., ix, 1835, p. 191; Serville, Ins. Orth., 1839, p. 310; Saussure, Mém. Soc. Genève, xxv, 1877, p. 38; Saussure and Zehntner, Rev. Suisse Zool., ii, 1895, pp. 422-430 (*nec* Hübner, 1810, a genus of Mollusea).

Cylindracheta Kirby, Syn. Cat. Orth., ii, 1906, p. 7; Giglio-Tos, Ann. Mus. Civ. Nat. Genova, xlvi, 1914, p. 83.

Form cylindrical, mesothorax of large dimensions, closely joined to prothorax. Head with antennae seven-segmented in both sexes (or eleven-segmented); mandibles with sharp cutting teeth; a stridulatory file with many teeth on dorso-lateral margin; maxillary palpi five-segmented, the third article large, a stridulatory apparatus present near base on internal face, composed of a few teeth; eyes simple. Anterior tibiae with large internal auditory chambers, external orifice concealed; tarsi composed of one (or two) segments, without claws. Median and posterior legs capable of folding into depressions on thorax and abdomen; median tarsi composed of two segments with paired (or single)

claws; posterior tarsi composed of a single segment without claws (or two-segmented with a single claw).

Genotype: *C. campbelli* Gray.

The above description has been drawn up from fresh material. The characters in brackets are those given for *C. kochi* by Saussure. If all the features attributed to the two early described species are confirmed on their re-discovery, the three new species described below will require to be placed in a separate genus.

The visual apparatus in *Cylindracheta* consists of a pair of relatively large simple eyes, not as in *Gryllotalpa* of compound ones.

From the examination of sections of the head of *C. arenivaga*, kindly prepared for me by Mr. F. G. Holdaway, it may be seen that the eyes are ocelliform, are covered with a thin cuticular membrane, and possess a large cellular lense, a visual layer, pigmented sheath, and large optic nerve. The condition of the material available for sectioning is not sufficiently good for the appreciation of fine details of structure; the figure given (fig. 9 C) is therefore diagrammatic. In front of the eyes and a little above them there is usually present a thin suture, which apparently ends blindly in the deeper cuticular layers; still further forward there is a pale circular area of chitin (in the position of the lateral ocellus of *Gryllotalpa*). This may be the remains of a degenerate simple eye and homologous with the "fenestra," which is found in a similar position in the cockroaches (Blattidae).

A well-developed, buccal stridulatory apparatus is present in all three of the species examined. In *C. arenivaga* the file consists of about twenty rows of small teeth, arranged in series of from four to seven (fig. 9 G, H). The strigilator is on the third segment of the maxillary palpi, and is formed of a series of seven elongate ridges or teeth (fig. 9 E, F), which move over the strigil in a vertical direction.

An auditory apparatus is present in the anterior tibiae. There is what appears to be a tympanum on the inner margin of the tibiae near the base, in a position normally concealed by the internal apical process of the femora; near this tympanum an elongate internal mass of white tissue (probably an oil gland) is clearly visible through the semi-transparent derm; an enlarged trachea is seen also to occupy two-thirds of the length of the tibia. No external opening to this apparatus has been detected on the tibia, but a well-defined orifice appears to be concealed between the pro- and mesothorax in a similar situation to the thoracic tracheal opening of *Gryllotalpa*.

KEY TO SPECIES OF CYLINDRACHIETA.

- A. Anterior tarsi two-segmented *campbelli*
- B. Anterior tarsi one-segmented,
- a. Median tarsi two-segmented, with paired claws, posterior tarsi one-segmented, without claws.
- a. Median tibiae with external lateral longitudinal chitinous ridge; posterior tibiae with ridge obsolete *psammophila*
- b. Median and posterior tibiae both with lateral ridges.
1. Median tibial ridge feebly bidentate . . . *longaeva*
2. Median tibial ridge strongly bidentate . . . *areniruga*
- b. Median and posterior tarsi two-segmented, with single claws (after Saussure) *kochi*

CYLINDRACHIETA CAMPBELLI Gray.

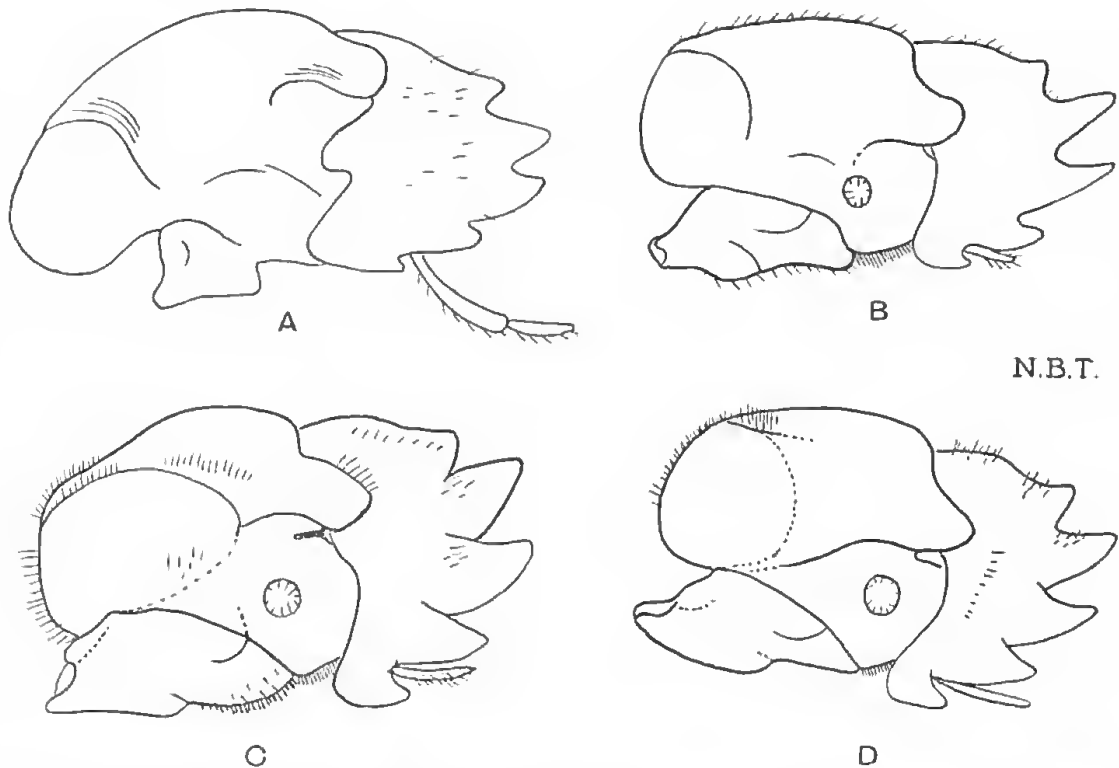
Fig. 8 A.

Cylindrodes campbelli Gray, Griffiths, Animal Kingdom xv, 1832, p. 785, pl. 131; Mag. Nat. Hist., (2) i, 1837, p. 142, fig. 15; Saussure, Mém. Soc. Genève, xxv, 1877, p. 40.

Smooth. Head small, triangular, dark brown; antennae apparently moniliform (only a few basal segments remaining in the unique specimen); labrum small, horse-shoe shaped. Mandibles small, strongly dentate; eyes very small; palpi with terminal joint truncated, somewhat rounded, and slightly enlarged towards the tip. Body very long, cylindrical; thorax reddish-brown, occupying more than a third of its whole length, distinctly divided into pro-, meso-, and metathorax; the prothorax the longest and cylindrical, the other two segments subequal. Abdomen (except the last joint) yellowish-brown with a tinge of darker colour, composed of eight segments, the last the largest, with its apex rounded, depressed and margined above, and devoid of caudal appendages. Anterior legs moderately strong, compressed and dentated in front; the tarsi composed of two long slender segments without a claw. Median and posterior legs yellowish-brown, with darker tinges, very short, compressed, and received in cavities on each side of the body (the cavities which receive the median pair of legs occupy the spaces between the meso- and metathorax, while the third pair are contained in the interval between the metathorax and the first abdominal segment); femora broad and armed at the apex with a blunt spine, serving as a guide to the tibiae when in the act of being drawn beneath them; tibiae broad, compressed, and strongly armed with a short spine at the tip; tarsi biarticulated, ciliated beneath and furnished with a small claw.

The species has not been rediscovered since its first capture on Melville Island in 1826-1827; the above account has therefore been drawn up from Gray's original descriptions and figures.

There is evidence of some confusion in Gray's account with regard to *C. campbelli* and the "wire-worm." He says: "Brought from Melville Island, on the north coast of New Holland, by Major Campbell, who informed me that he was unable to keep a single plant in his greenhouse on account of the ravages of this insect. It bores in their stems; and the withering of the plants alone betrays the secret work of the spoiler. . . . The name given to this insect by the colonists was the 'wire-worm'."



N.B.T.

Fig. 8. *Cyindracheta*, anterior leg, internal aspect in: A, *C. campbelli* Gray, Melville Island (after Gray); B, *C. arenivaga* sp. nov., Stuart Range; C, *C. longuerra* sp. nov., New Guinea; D, *C. psammophila* sp. nov., Perth.

The term, "wire-worm," in Australia, is generally applied to species of millepedes (Myriapoda), and more correctly to the larvae of Elaterid beetles. Probably Gray has confused two or more statements by Major Campbell relating to different animals. As showing that some misunderstanding has occurred, it should be pointed out that in such an intensely hot climate as that of Melville Island (11° 30' south lat.) it is most improbable that Major Campbell kept any plants in a greenhouse. On the other hand, in New South Wales and Tasmania, where he also resided, true "wire-worms" are pests in greenhouses, and he may well have been troubled with them.

Both of the species of *Cyindracheta* whose habits are known to us are

burrowers in sand. Is it not possible that the present species also is normally a sand-dweller, and that its discovery in stems of plants (if indeed true) was due to an occasional departure from normal habit, such as been recorded of *Gryllotalpa africana* in Hawaiian sugar-cane? In Major Campbell's ⁽¹⁰⁾ own account of the Melville Island Settlement the only insects which are mentioned as causing damage to the belongings of the residents are termites, whose ravages amongst the roots and in the stems of living plants are only too well known to those of us who have practised agriculture in North Australia.

This species is distinguished from its congeners by the two-segmented anterior tarsi and by the different anterior tibiae and posterior legs. Gray's figure of the anterior leg was drawn in an inverted position, with the tibia partly dislocated from its socket. The figure (fig. 8 A) has been redrawn, with a modification of position, for comparison with those of the other species of the genus. According to Gray's figures the prothorax is almost twice as long as wide, and is therefore much more slender than in any other of the known species.

CYLINDRACHETA ARENIVAGA sp. nov.

Figs. 8 B, 9, and 10 B-C.

♂ Comparatively small, elongate, cylindrical. Head, thorax, and apex of abdomen smooth, polished, light chestnut-brown; abdomen and legs paler. Head moderately broad, eyes small, broadly oval, fenestrae inconspicuous; antennae moniliform, seven-segmented, basal segment large, third small. Prothorax moderately stout (length-breadth index 73), anterior margin strongly concave, antero-lateral spine not very conspicuous. Mesothorax compressed posteriorly; metathorax laterally compressed. First, second, and base of third segments of abdomen laterally compressed, the first segment flattened above into an amygdaloid shape, the second into a conical shape; third to eighth segments wider than long; apical segment distinctly longer than wide with apex truncate, a median transverse suture above; cerci short, somewhat slender; tenth tergite longer than wide, with the posterior (anal) margin angulate; ninth sternite with posterior margin produced to a blunt median point; copulatory hooks on the tenth sternite conspicuous. Anterior legs with femora stout, internal apical projection well rounded below; tibiae with digitiform blades comparatively long and slender, tarsus one-segmented, short. Median legs with femora stout, two-thirds as wide as long; tibiae stout, with a longitudinal ridge on external face produced into two conspicuous lobes near the apex, which bears also two terminal spines; tarsi two-segmented, with small, stout, blunt, paired claws. Posterior legs with femora stout, nearly two-thirds as wide as long; a plain

(10) Campbell, Royal Geographical Society Journal, iv, 1834, pp. 129-181.

longitudinal ridge on external face reaching nearly to apex, which is armed with four spines, the external pair rather long and slender; tarsus composed of a single segment, sharp-pointed at apex, without claws. Length, 41 mm.; of pronotum, 6.4 mm.; breadth, 4.7 mm.; cerci, 1.3 mm.

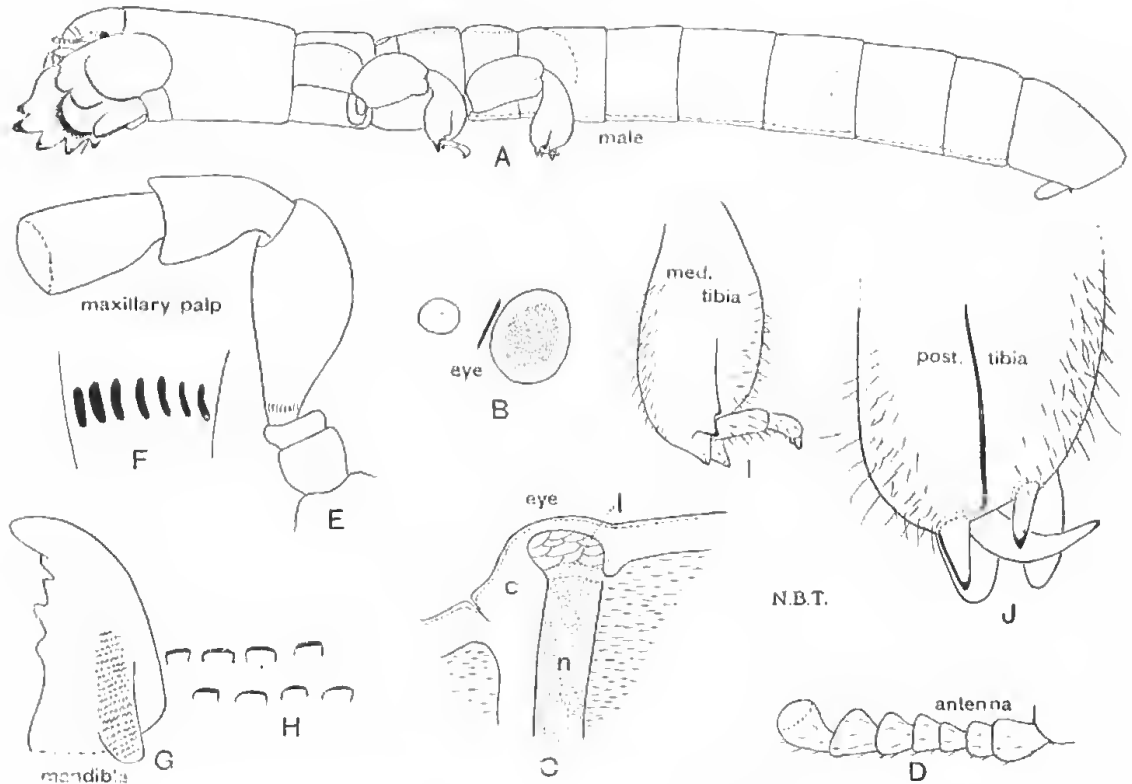


Fig. 9. *Cylindracheta arcivaga* sp. nov. A, adult male; B, eye and fenestra; C, horizontal section of eye (c, cuticular layer; l, lens; n, nerve); D, antenna; E, right maxillary palp showing strigilator on third segment; F, ditto, further enlarged; G, left mandible, external aspect, showing strigil; H, ditto, teeth of strigil enlarged; I, median tibia and tarsus; J, apex of posterior tibia and tarsus.

♀ Similar to male. Prothorax stouter (length-breadth index 83). Abdomen with cerci somewhat stouter, eighth sternite about twice as long as wide, with the posterior margin strongly convex (fig. 10 C); gonapophyses normally concealed. (In fig. 10 D the apex of the abdomen is drawn from an oblique direction with the eighth sternite elevated, to show the positions of the gonapophyses and gonopore.) Length, 40 mm.; of pronotum, 5.9 mm.; breadth, 5.0 mm.; cerci, 1.5 mm.

Loc. South Australia: Fowler's Bay (R. Tate), Denial Bay (J. W. G. Mann), Nullarbor Plain (R. T. Maurice), Wynbring, Ooldea (A. M. Lea), Lake Callabonna (A. Zietz), Strzelecki Creek (E. R. Waite). Central Australia: Stuart Range (P. Wood Jones). North Australia: Tennant Creek (J. F. Field).

The type (a male) from the Stuart Range and the allotype (female) from Tennant Creek, numbered I. 14913, are in the South Australian Museum. This species is widely spread over the arid parts of Australia, and is somewhat variable in size and proportions. Twenty examples have been examined; most of them are constant in having the prothorax three-fourths as wide as long; the type female is exceptionally broad. Three examples from Nullarbor Plain, Wynbring, and Ooldea have the abdominal segments as long as or longer than wide, but I can find no constant differences; much of the apparent variation may be due to contraction or telescoping of the segments.

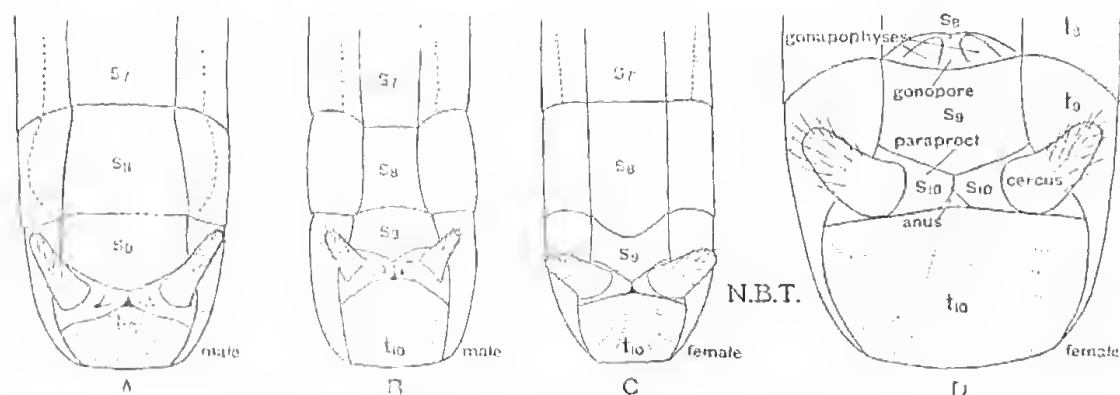


Fig. 10. *Cylindracheta*, apex of abdomen beneath in: A, *C. psammophila* sp. nov., type male; B, *C. aceniraga* sp. nov., type male; C, ditto, allotype female; D, ditto, female, viewed from oblique angle to show rudimentary gonapophyses.

There are seven larval examples of the species in the type material, amongst which may be distinguished what are probably the three instars prior to the adult condition. The two smallest examples are both 20 mm. in length (pronotum 3.0–3.1). They are honey-coloured, with the basal segments of the abdomen and the two posterior pairs of legs creamy-white. They agree in proportions and in the armature of the legs with the adults. Examples of the next instar vary from 31 mm. to 32 mm. in length (pronotum 3.8–4.5 mm.); they are similar in other respects to those of the preceding stage. The antepenultimate instar is represented by two individuals 38 mm. to 39 mm. in length (pronotum 5.9–6.2 mm.).

Examples of these three stages and of the adult, including the type male, were taken by Professor F. Wood Jones. They were burrowing just below the surface of the ground in sandhills at Stuart Range. An adult male of this species was also taken in a similar habitat by the late Mr. E. R. Waite during the South Australian Museum Expedition to Cooper Creek in 1916. He described its capture as follows: "On September 25, when traversing the sandhills in the neighbourhood of Strzelecki Creek, I noticed long tracks in the sand, each

terminating in a round hole; these tracks were often punctured, evidently by birds searching for the contained insect. I made many attempts to secure what I thought might be a mole-cricket, and finally succeeded in obtaining a single specimen." This example was figured under the name of *Cylindrodes campbelli* Burmeister in the account of the expedition (11).

Little is known about the life history or feeding habits of these insects. The stomach and intestinal contents of a male example from Wynbring consisted of many fragments of insect chitin and a few vegetable cells, suggesting that the omnivorous habits of *Gryllotalpa* are found in species of this group also.

CYLINDRACHETA LONGAeva sp. nov.

Fig. 11.

♀ Elongate, cylindrical, light ochreous-brown in colour, with the external faces of the anterior femora and tibiae chestnut-brown. Head moderately broad, eyes small, oval, prominent, fenestrae not very conspicuous, antennae monili-

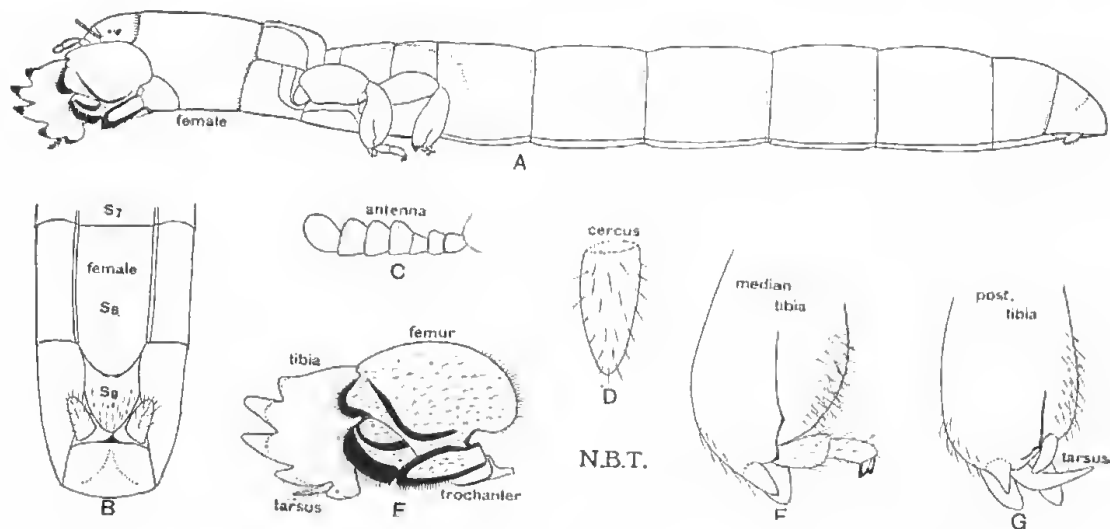


Fig. 11. *Cylindracheta longaeva* sp. nov. A, adult female; B, apex of abdomen beneath; C, antenna; D, cercus; E, anterior leg, external aspect, showing broad elevated chitinous ridges on femur; F, apex of median tibia and tarsus; G, apex of posterior tibia and claw-like tarsus.

form, short, seven-segmented, the third segment small. Prothorax broad, cylindrical (length-breadth index 78), anterior margin evenly concave, antero-lateral spine moderate, densely hairy; mesothorax moderate, compressed posteriorly to permit of the folding in of the median legs; metathorax greatly compressed laterally, with upper margin short, depressed, and lamellate. Three basal segments of abdomen compressed, the first with its upper-surface flat and

(11) Lea, A. M., Trans. Roy. Soc. S. Australia, xli, 1917, pl. xxxiii, fig. 4.

amygdaloid in shape, the second conical, the third compressed only at base; third to seventh segments of abdomen longer than wide, constricted slightly at each joint; the terminal segment bears a median transverse suture; beneath, the eighth sternite is very long, with the posterior margin strongly convex; cerci short and stout, twice as long as wide; the tenth tergite bears lateral depressions for the reception of the cerci in repose, these do not reach apex of abdomen. Anterior legs with femora moderately stout, the inner apical projection sub-rectangular, the chitinous ridges of external face broad (indicated in black in fig. 11 E); tibiae stout, with single-segmented tarsus, moderately long. Median legs with femora nearly four-fifths as wide as long; tibiae stout, with a long ridge on external face projected near and at apex into two rounded prominences, armed apically with two spines; tarsi two-segmented with stout, paired claws. Posterior legs with femora twice as wide as long; tibiae stout, with a short longitudinal ridge on exterior face produced near apex into a blunt spine, preceded by a second slight elevation, armed apically with four spines, the external pair of which are small; tarsus composed of a single, long, sharp-pointed segment, without claws. Length, 56 mm.; of pronotum, 7.7 mm.; breadth, 6.0 mm.; cerci, 1.5 mm.

Loc. New Guinea. Type, a female, unique, K. 55948 in the Australian Museum collection. The discovery of *longueva*, an ancient inhabitant, extends the range of the subfamily towards the northern confines of the Australasian region. Unfortunately no further details concerning its capture have been preserved.

CYLINDRACHETA PSAMMOPHILA sp. nov.

Fig. 12.

♂ Cylindrical, stout, light chestnut-brown in colour. Head broad, large; antennae moderately stout, short, moniliform, and seven-segmented; eyes ovate, the pale-coloured fenestrae conspicuous. Prothorax stout, broad (length-breadth index 85), anterior margin above gently concave, the antero-lateral protuberances or spines stout and sharp. Mesothorax stout, posteriorly deeply excavated to accommodate the folded median legs. Metathorax compressed, the upper extremity short and lamellate. The three basal segments of abdomen compressed, the first with median ridge flattened and oval, the second elongate, rectangular, the third triangular; the eighth tergite bears a median longitudinal groove (as this is almost absent in a second male example it may be due at least in part to post-mortem deformation), traces of which occur on the adjoining segments; the apical segment of body short, as wide as long, with the sides converging to apex, the apex truncate; the tenth tergite ventral, wider than long, with

elongate lateral depressions for the reception of the cerci, the apical (anal) margin projected and rounded; cerci three times as long as wide, densely hairy; clasping hooks on tenth sternite conspicuous (fig. 12 A). Anterior legs with femora stout; the internal apical process rounded, the chitinous ridges on external face narrow but strongly elevated; tibiae moderate, with tarsus one-segmented and rather long. Median legs with femora very broad; tibiae stout, armed apically with two spines, and bearing a longitudinal ridge on the external face, elevated into two slight broad projections, the one at the apical extremity the larger; tarsi two-segmented with stout paired claws. Posterior legs with femora relatively narrower than those of median ones; the tibiae longer and less expanded, with the hind margin comparatively straight, armed apically with four spines, the external pair the smaller; there is no longitudinal ridge on the external face; tarsus composed of one long segment tapering to a point, without traces of claws. Length, 43 mm.; pronotum, 8.4 mm.; breadth of pronotum, 7.1 mm.; cerci, 2.3 mm.

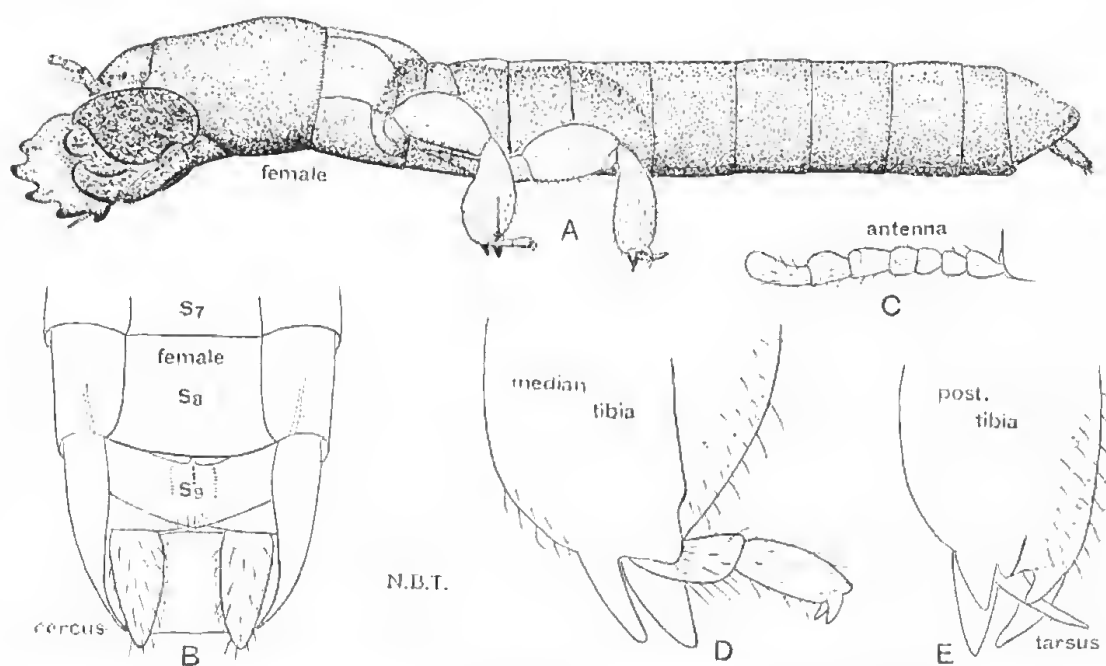


Fig. 12. *Cylindracheta psammophila* sp. nov. A, adult female; B, ditto, apex of abdomen beneath; C, antenna; D, apex of median tibia and tarsus; E, apex of posterior tibia and tarsus.

♀ Similar to male but larger. Antennae more slender, seven-segmented. Pronotum slightly narrower, abdomen with dorsal groove absent; cerci long, and projecting beyond apex of abdomen; the ninth sternite three times as wide as long. Length, 48 mm.; pronotum, 10.5 mm.; breadth of pronotum, 8.3 mm.; cerci, 2.5 mm.

Loc. Western Australia: Swan River, near Perth (H. W. Davey), the type, a male, and allotype female, l. 14912, in South Australian Museum; Perth, one paratype male, K. 33721, in Australian Museum; Geraldton (E. Ashby, October, 1927).

The female example is very light in colour, and had probably only just passed through the final ecdysis when captured. The male in the Australian Museum collection is somewhat more elongate than the type. It is the example figured by Tillyard⁽¹²⁾ under the name of *Cylindracheta kochi*.

This species lives in sandy country near water; it burrows just beneath the surface in search of food, just as do the species of *Gryllotalpa*. Mr. A. M. Lea informs me that on one occasion, when digging up a peach tree in sandy country near Perth, he met with burrows and several individuals of this species in the sand.

Mr. E. Ashby recently picked up a single example, lying dead on the surface of a sandhill near Geraldton. The anal extremity had been mutilated and the thorax pierced, possibly by a bird. It is smaller than examples from the type locality, the ridge on the posterior tibia is slightly more developed, and the prothorax is less broad (index 77).

CYLINDRACHETA KOCHII SAUSSURE.

Cylindrodes kochii Saussure, *Mélanges Orth.*, ii, 1877, p. 208, pl. ii, fig. 3;

Saussure and Zehntner, *Rev. Suisse Zool.*, ii, 1894, p. 428.

Cylindracheta kochii Kirby, *Syn. Cat. Orth.*, ii, 1906, p. 7.

“Rufescens, nitida; pronoto pedibusque fimbriatis; oculis minutis, maculis 2 flavis ocellaribus; antennis brevissimis; femoribus 2is 3iis apice *inermibus*, tibiis anticis angustioribus, margine postico arcuato, integro; tarso antico uniaarticulato, reliquis biarticulatis; femoribus posticis paulo longioribus quam intermediis; abdominis segmentis 1o, 2o superne lamellari-compresso, tertio compresso, superne trigonali.”

“Longueur du pronotum 9.5 mm.; largeur du pronotum 6.4 mm.”

“*Habite*: La Nouvelle-Hollande (Musée de Genève).”

Professor Dr. A. Reichenperger has kindly examined Saussure's type material, and has supplied the following note: “I am sending you some details about that ruined specimen in the Geneva Museum which is labelled *Cylindrodes kochii* Saussure. It must be the type; it is a pity Saussure never marked them! Of the antennae there is only one left, and this is sticky and dusty, surely repaired; it is impossible to tell how many articles there may have been; actually there are about six or seven, never eleven. On the hind legs there are no farsi, they may be

(12) Tillyard, R. J., *Insects of Australia and New Zealand*, 1926, pl. 7, fig. 12.

broken off; the single 'mobile spine' is not there. On the middle legs there is a two-jointed tarsus but no paired claws (if not broken away). There are no palpi left on the type. The *C. kochii* is further labelled 'Nord de la Nlle. Hollande.' There is another broken example in the collection, labelled '*C. campbelli* ? Gray, Swan River.' It looks just like the other ruin, but has two stout claws on the middle tarsus."

The type of *C. kochi* was unique. Saussure stated (in the explanation to his figure) that the posterior tarsi were missing, but in the text makes several statements, regarding them and other appendages, some of which are seemingly contradictory. In defining his group *Cylindrodites*, for instance, he says: "Pattes des deux autres paires tres courtes, . . . leurs tarses biarticulés" (the italics are mine). In the generic description he says: "Tarses des 2^e et 3^e paires courtes, composés de 1 ou 2 articles, et terminés par une griffe unique." Under the specific heading he says, however, "tarso antico uniaarticulato, reliquis biarticulatis"; and again: "Tibias des deux paires à peu près égaux. Tarses composés de 2 articles."

As indicated in the second of the above quotations, Saussure says that the median tarsi have only a single terminal claw. The antennae are said by him to be eleven-segmented, "composées de onze articles," although his figure shows only about seven. An apparent tenth abdominal tergite is indicated in dotted outline in his figure.

One is inclined to doubt the correctness of some of the above statements, but since Giglio-Tos has recently said that in his Patagonian species also the median tarsi have only a single claw, Saussure's observations on this point, for instance, may be correct. As all three species before me have seven-segmented antennae, two-segmented median tarsi with paired terminal claws, one-segmented posterior tarsi without claws, and viewed from above only nine apparent abdominal segments, Saussure's statements are open to criticism. Even if *C. kochi* is proved to have had similar appendages to those of the examples before me, the description and figure agree so little with them that we may at present safely venture to regard it as a little known and improperly described species whose habitat is "Nord de la Nlle. Hollande."

The second (Swan River) example mentioned by Dr. Reichensperger is evidently the one described and figured some years later by Saussure and Zehntner⁽¹³⁾, who in a footnote suggest that it may be *C. campbelli*. The presence on both the median and posterior tibiae of a smooth ridge or lobe (as stated by them) indicates that it is probably an example of *C. arenivaga*; an

(13) Saussure and Zehntner, l.c. p. 429, pl. xvi, figs. 17-19.

examination of the specimen would, however, be necessary for certain identification. The pronotum of the type of *C. kochi* is comparatively long and slender (length-breadth index 67), and in this character comes nearest to examples of *C. arenivaga*.

CYLINDRORYCTES gen. nov.

Cylindracheta Giglio-Tos, Ann. Mus. Civ. Stor. Nat. Genova. xlvi, 1914, p. 83 [part].

Antennae shorter than length of head, moniliform, composed of seven segments in the male and eight segments in the female. Eyes elliptical, minute, depressed. Ocelli absent. Pronotum cylindrical. Mesothorax separated from prothorax by a gracile collar (much constricted), which permits of extreme mobility between the two segments. Anterior tarsi composed of two segments. Median tarsi two-segmented with a single claw. Posterior tarsi one-segmented with very small paired claws or apical projections.

Genotype: *C. spegazzinii* Giglio-Tos.

CYLINDRORYCTES SPEGAZZINII Giglio-Tos.

Fig. 13.

Cylindracheta spegazzinii Giglio-Tos, Ann. Mus. Civ. Stor. Nat. Genova, xlvi, 1914, pp. 81-101, pl. i, figs. 1-11.

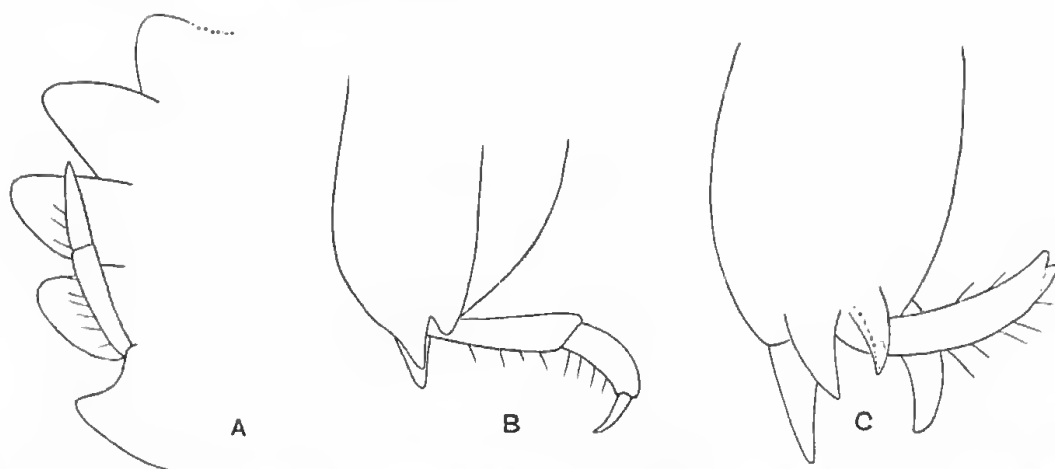


Fig. 13. *Cylindroryctes spegazzinii* Giglio-Tos. A, dactyls of anterior tibia, and tarsus; B, apex of median tibia and tarsus; C, apex of posterior tibia and tarsus. (Retraced from pencil sketches by M. L. Chopard.)

This remarkable cricket was discovered by Professor C. Spegazzini on the sandy shores of Lake Nahuel Huapi, in Patagonia, at an altitude of 2,530 feet (71° west long. x 41° south lat.). In addition to the type pair two further examples have been taken, on the Rio Nequen, and are in the collection of M. L. Chopard.

The generic diagnosis has been drawn up from the detailed description by Giglio-Tos, which occupies twenty-one pages. The example regarded as a male by him is undoubtedly a female, and *vice versa*. The terminal segments of the abdomen, as figured by him, appear very different from all the Australian species, but the copulatory hooks on the paraprocts of the tenth sternite have their parallels in the males of species of *Cylindracheta*. The ninth sternite of the female is twice as long as wide in the Patagonian species, whereas in the Australian forms it is usually wider than long.

I am indebted to M. Chopard for the accompanying figures showing details of the tarsi. He has also kindly supplied the following comments: "The anterior tarsus is very neatly two-jointed; the median tarsus bears only one claw, and the same tibia no posterior spur, such as is shown in your sketch [of *Cylindracheta arenivaga*, *vide* fig. 8 B]; the posterior tarsus bears two very small claws at the apex."

Subfamily Tridactylinae.

Only one genus is known to occur in the Australasian region; comments are therefore made under the generic heading.

TRIDACTYLUS Olivier.

Tridactylus Olivier, Encyclopedie Méth., Ins. iv, 1789, p. 26; Serville, Ins. Orth., 1839, p. 311; Saussure, Mém. Soc. Genève, xxv, 1877, p. 44; Saussure and Zehntner, Rev. Suisse Zool., ii, 1895, p. 411; iv, 1896, p. 407; Kirby, Syn. Cat. Orth., ii, 1906, p. 8 (full synonymy).

Nya Latreille, Gen. Crust. Ins., iv, 1809, p. 383.

Heteropus Palisot de Beauv., Ins. Afr. Amér., 1805, p. 231.

Type: *Tridactylus digitatus* Coq., W. Africa.

Some forty species of the genus have been described from subtropical and tropical America, Africa, Europe, and Asia. Some of them are separated by colour alone, and obviously inaccurate statements appear to have been made regarding the structure and armature of others. Even in the European *T. variegatus* one cannot learn from the various figures and descriptions the correct numbers of lamellae on the posterior tibiae (actually there are four external and three internal marginal ones). Some of the earlier described Asiatic species are probably composite, or the names are applied indiscriminately to several closely allied forms.

Several characters quite useful for specific separation have been apparently unobserved, and the value of others discounted. On the lower internal margin of the anterior femora in all of the species examined by me there is present a set of semi-transparent specialized spines arranged to form a comb.

Often, as in *T. variegatus*, the spines are simple, flattened and grouped in pairs, but in at least one species (*T. inflata* Brunu., Sumatra) they are very broad, flattened, and partly bisected to form series of two-pronged forks. Contrary to what has been stated by some other authors, the presence or absence of wings appears to be quite a constant character, in many species, and one useful, within limits, for specific separation.

The proportions of the appendages are important. They were mounted in Canada balsam, and measured with an eye-piece micrometer. The lengths of the whole insects are measured from the anterior extremity of the head to the apex of the abdomen, exclusive of the appendages.

The species of this genus live in the banks of streams and lagoons, where they hollow out tunnels at the water's edge. They travel with great agility over the surface of the water, and are even capable of diving beneath the surface. For swimming purposes seven broad, flat, articulated, paddle-like flanges or lamellae are developed on the posterior tibiae.

Auditory and stridulating organs have not been previously noted in members of this subfamily. The Asiatic and Australian species of the genus *Tridactylus* may, however, be divided into two groups, based on the presence or apparent absence of these organs, a preliminary account of which is given herewith.

The species of the *T. variegatus* group (*variegatus*, *japonicus*, *mutus*, etc.) are dumb, but others, such as *T. inflata* and its allies, and two new Australian species described in this paper, possess (on the apical part of the elytra) a strigil similar in appearance to that developed in *Gryllotalpa*. A specialized organ (probably auditory in function) is developed on the dorsal surface of the apparent first segment of the abdomen. It consists of a broad, sub-rectangular membrane, stretched between anterior and posterior transverse chitinous ridges. In *T. musicus* it is three-fourths as long as the prothorax. The scantiness of my material has up to the present precluded a detailed examination of the structure.

KEY TO AUSTRALIAN SPECIES OF TRIDACTYLUS.

- | | | |
|--|---------|--------------------|
| A. Metatarsus much shorter than superior apical spurs of posterior tibiae | | <i>mutus</i> |
| B. Metatarsus as long as or longer than superior apical spurs. | | |
| a. Posterior tibiae with one external and two internal (i.e., 1 + 2) marginal serrations | | <i>tantillus</i> |
| b. Posterior tibiae with three external and four internal (3 + 4) marginal serrations | | <i>musicus</i> |
| c. Posterior tibiae "with two small obtuse teeth" (Mjöberg) | | <i>australicus</i> |

With the increase of our knowledge of these minute crickets the numbers of serrations on the posterior tibiae may be found to be variable. In *T. mutus* the males appear to have 4 + 4 serrations, whereas the females possess 4 + 5.

TRIDACTYLUS MUTUS sp. nov.

Fig. 14.

♂ Head, prothorax, and posterior femora dark green. Head with antennae short, stout, and moniliform, cupreous-green, clothed with fine pubescence, first segment stout, second moderate, third longer than second and any of the following except the apical (tenth) one, which latter is somewhat swollen and elongate-ovate; labrum transverse, anterior margin well rounded; clypeus narrowly transverse; ocelli, three, small but conspicuous; eyes large, projecting, sub-angulate, upper margin bordered by a pale whitish fascia; vertex smooth with a few scattered punctures. Prothorax transverse, one-sixth wider than long, smooth, sparsely punctured, dark green with cupreous reflections, except for a whitish triangular area at postero-lateral angle. Abdomen dark brownish-green beneath brown, posterior margin of each sternite whitish, giving abdomen a transverse banded appearance, anal appendages brown, apical sternite (ninth) as long as or longer than wide, the hind-margin well rounded. Elytra twice as long as wide, extending only to middle of length of abdomen, obliquely rounded at apex, opaque dark brown, the whole surface covered with minute fish-scale like impressions. Wings obsolete, when in repose scarcely protruding beyond elytra. Anterior legs with femora armed on inferior internal margin with a fine comb of about fifteen specialized spines; tibiae armed with four dactyls and a row of stout hairs, long on the anterior margin and short on the posterior; tarsi two-segmented, the first incompletely divided by an inferior groove. Median legs with tibiae moderately stout, tarsi two-segmented, first segment deeply constricted and furnished with semi-transparent pads beneath. Posterior legs with femora extending beyond apex of abdomen; tibiae strongly curved, with eight serrate projections on upper margins, four external and four internal, armed also with seven subapical lamellae, four external and three internal, the latter ones larger and broader than the others; two superior subapical spines and two inferior apical ones are also present, the former pair one-third the length of the latter; metatarsus composed of a single obsolete sub-spherical segment one-third the length of the subapical spines. Length, 4.0 mm.; of pronotum, 1.1 mm.; breadth of pronotum, 1.3 mm.; length of elytra, 1.5 mm.; of posterior femora, 2.8 mm.

♀ Similar to male, but larger. Eighth sternite of abdomen notched on posterior margin; ninth sternite with median longitudinal impressions. Posterior

tibiae armed with four external and five internal marginal serrations. Length, 5.1 mm.; of pronotum, 1.5 mm.; breadth of pronotum, 1.7 mm.; length of elytra, 1.5 mm.; of posterior femora, 3.5 mm.

Loc. Queensland; Cairns district (F. P. Dodd); Brisbane (H. Haeker). New South Wales: Sydney (A. M. Lea); Woodford (A. J. Nicholson); Wallacia (H. M. Hale and N. B. Tindale, March, 1927); Condobolin; Howlong (W. W. Froggatt). South Australia: Murray River (F. R. Zietz); Highbury, near Adelaide (N. B. Tindale, December, 1923, type locality). Type (male) and allotype (female), 1. 14936, in South Australian Museum.

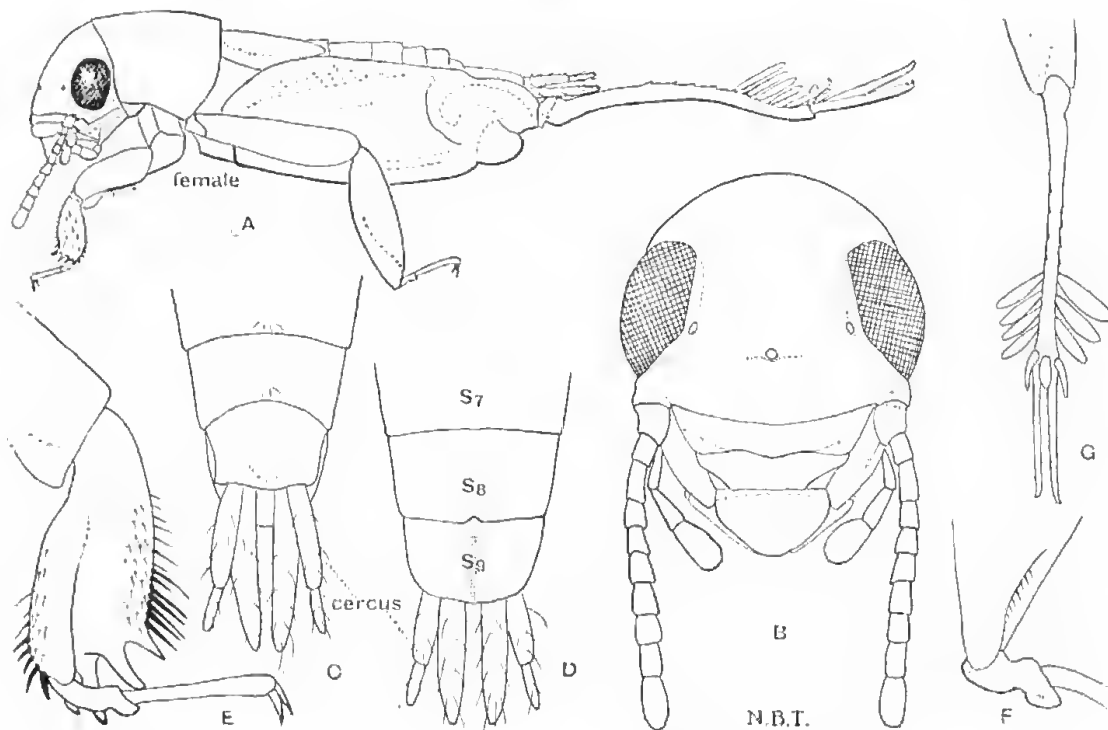


Fig. 14. *Tridactylus mutus* sp. nov. A, adult female; B, head; C, apex of abdomen above; D, ditto, below; E, left anterior tibia and tarsus, internal view; F, apex of median and first tarsal segment, internal view; G, left posterior tibia and tarsus, viewed from above.

The type examples were taken at dusk by sweeping vegetation at the edges of a swamp lagoon. Others were taken at Wallacia by throwing water against the sandy bank of the river; when washed out the creatures moved actively over the surface of the water and attempted to escape by digging into the bank at the water's edge. A single example was found adhering to the sticky seeds of *Pisonia brunoviana*, collected near Kuranda by Mr. F. P. Dodd. Little or nothing is known about the life history.

Some examples from Condobolin are more variegated in colour, and are slightly larger than the typical form. There are two curved whitish marks on

the posterior margin of the pronotum (near the middle line), and the posterior femora bear two short longitudinal marks and an irregular subapical whitish blotch. The abdomen beneath may be very light brown, with the whitish band on the posterior margins of the segments very broad. Structurally there appears to be little difference from the normal form.

Chopard ⁽¹⁴⁾ has identified examples from the Cairns district, probably of this species, as *T. japonicus*, from which species it is quite distinct.

Froggatt ⁽¹⁵⁾ has figured an example of *T. mutus* without detailed description, under the name of "*Nemobius* sp." Four internal marginal lamellae are shown on the posterior tibiae instead of three, otherwise the figure agrees with the specimens described above.

The median tibiae in this and the two following species contain a large oil gland, the product from which appears to be secreted on to the surface of the derm by numerous small pores, and serves, no doubt, to render the insects water-proof. (Fig. 15 E.)

TRIDACTYLUS TANTILLUS sp. nov.

Fig. 15.

♂ Head, pronotum, and elytra brown, darker laterally. Antennae pale brown with apex of each segment darker, pubescent, first segment moderately large, second to fourth decreasing in size, fourth only one-half length of eighth, fifth to seventh subequal, tenth the longest, cylindro-conical with blunt point; ocelli conspicuous; eyes large, hemispherical, coarsely faceted; vertex sparsely clothed with whitish pubescence. Pronotum nearly one-third wider than long, somewhat inflated, postero-lateral angle well rounded, lateral margin distinctly concave, wholly brown, very sparsely clothed with fine white hairs. Abdomen brown, beneath, especially at apex, paler; apical sternite strongly transverse, posterior margin well rounded, clothed with dense white pubescence; anal processes densely hairy; second segment of cerci slender, more than half length of first. Elytra (fig. 15 A) moderate, two and one-half times as long as wide, apex angulate, anterior margin strongly convex at base, three veins prominent, the subcostal one bears on its distal fourth a stridulating file composed of numerous transverse teeth (fig. 15 B). Wings present, long, when folded reaching to apex of cerci. Anterior legs with femora armed with a comb of fifteen semi-transparent, broad, flattened teeth; tibiae moderately clothed with coarse hairs and armed with four dactyls. Median legs with tibiae stout, tarsi

(14) Chopard, L., Arkiv för Zool., 18A, No. 6, 1925, p. 6.

(15) Froggatt, W. W., Australian insects, Sydney, 1907, pl. vii, fig. 4.

slender, first segment more than half length of second; second segment apparently capable of being bent into position of repose (fig. 15 E). Posterior legs with femora stout, not reaching extremity of abdomen; tibiae weakly curved, bearing on upper margins only three serrations (one external and two internal); armed with seven slender lamellae (four external marginal and three internal); Subapical paired spines distinctly hooked at apex, nearly one-half length of apical spines; metatarsus elongate; conical, as long as subapical spines, anterior margin regularly serrated, posterior margin with a row of fine hairs. Length, 3.6 mm.; of pronotum, 0.7 mm.; breadth of pronotum, 1.0 mm.; length of posterior femora, 2.3 mm.; of elytra, 1.5 mm.

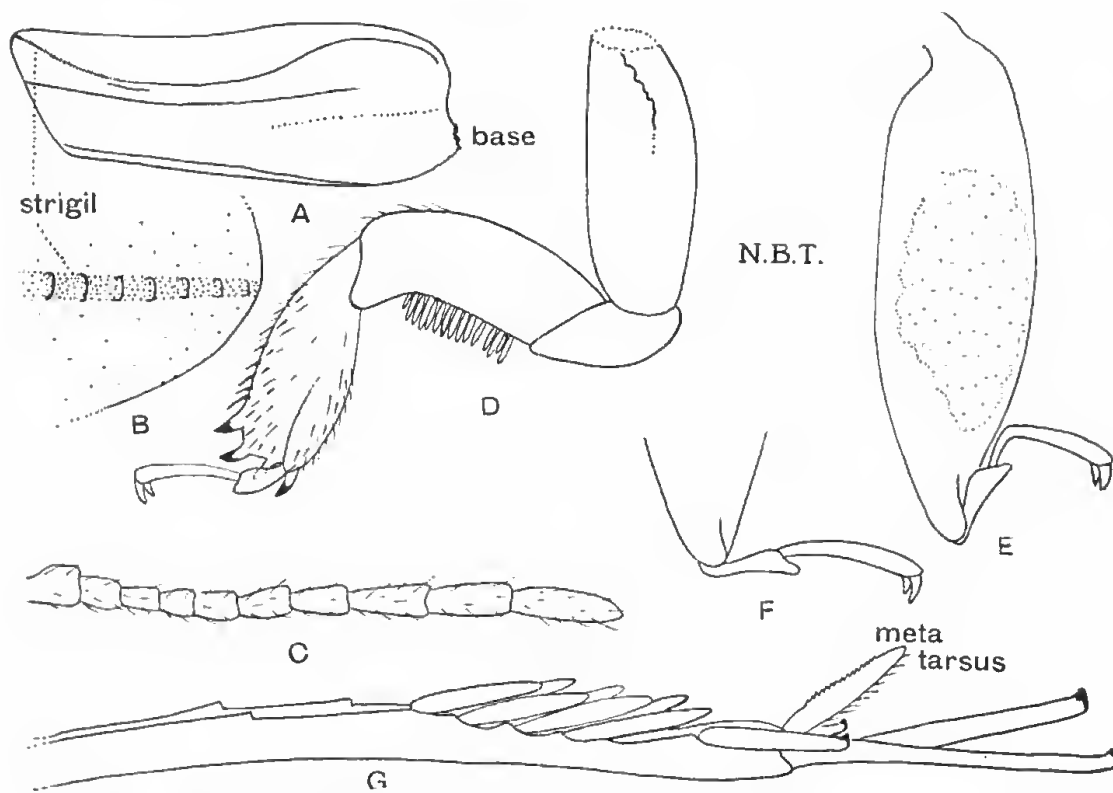


Fig. 15. *Tridactylus tantillus* sp. nov. A, clytron, viewed from beneath to show stridulatory teeth; B, ditto, part, greatly enlarged; C, antenna; D, right anterior leg, internal aspect; E, median tibia and tarsus, showing tarsus in position of repose; F, ditto, another position; G, apex of posterior tibia and tarsus, external aspect.

Loc. Northern Territory: Daly River (H. Wesselman). Type, unique. I. 14937, in South Australian Museum.

This species is smaller than *T. pulex*, the smallest species of the genus previously known, and differs from it in the presence of an elongate metatarsus.

TRIDACTYLUS MUSICUS sp. nov.

Fig. 16.

♂ Head, prothorax, and abdomen dark brown. Head with antennae pale brown, stout, finely pubescent; basal segment stout, second and third nearly as long as first, fourth the shortest, fifth and sixth as long as second, seventh and eighth subequal, together equal to three times length of fourth, apical segment (tenth) the longest; eyes moderate, ocelli rather large and conspicuous; vertex

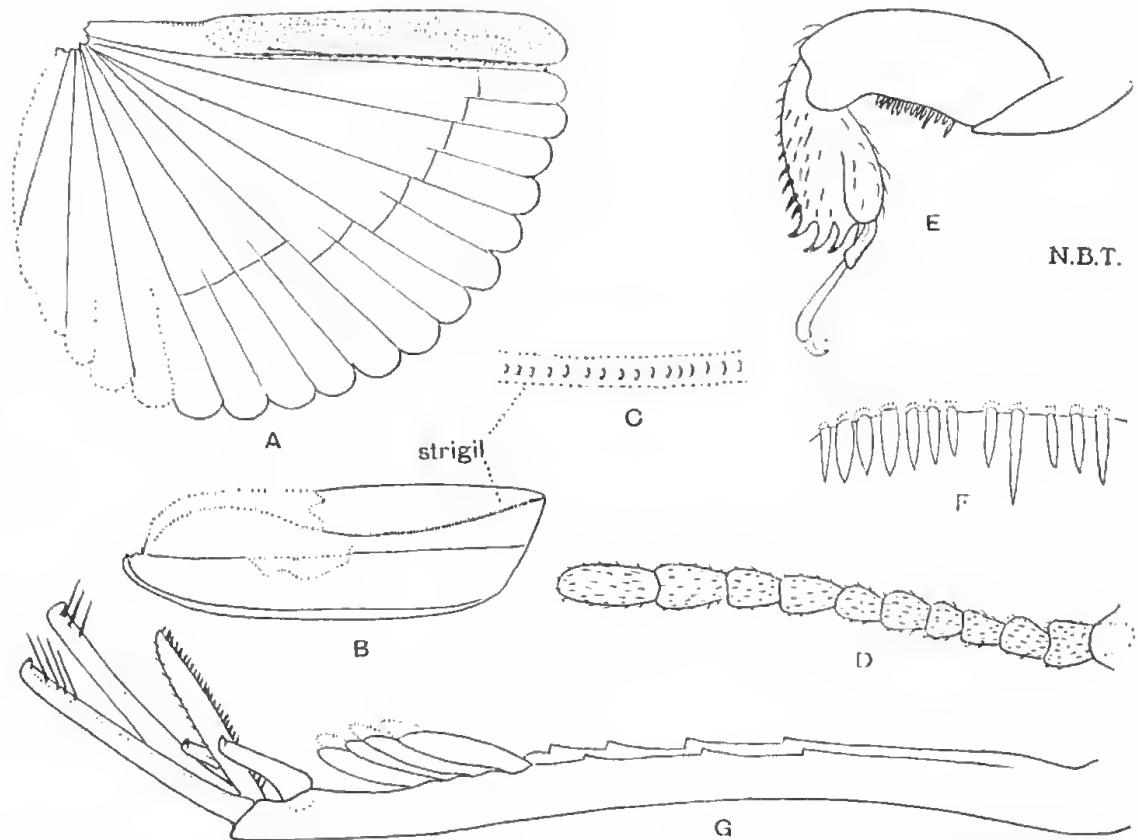


Fig. 16. *Tridactylus musicus* sp. nov. A, wing, the anal part indicated approximately; B, elytron, showing strigil, basal third of anterior margin broken away; C, part of strigil, greatly enlarged; D, antenna; E, right anterior femur, tibia and tarsus, showing femoral comb; F, femoral comb, greatly enlarged; G, apex of right posterior tibia and tarsus, external aspect.

smooth, with a few scattered hairs. Prothorax brown, with a slight metallic lustre; one-fourth wider than long, lateral margin concave, postero-lateral angle well rounded, the whole surface finely marked with tiny impressions, like fish-scales, and clothed with scattered whitish pubescence. Abdomen beneath pale brown; the apparent apical sternite transverse, posterior margin indistinctly angulate, sparsely clothed with whitish hairs; cerci with second segment slender,

nearly as long as first. A large sub-rectangular tympanum present dorsally on apparent first abdominal tergite. Elytra three times as long as wide, dark brown, with apex, part of costa, and a submarginal spot paler; apical three-sevenths of subcostal vein armed on inferior surface with a stridulatory file composed of many narrowly transverse teeth. Wings (fig. 16 A) present, moderate, in repose extending to apex of first segment of cerei, light brown, with the upper (not costal) margin fringed with hairs and marked with regular alternate paler bars, the fan transparent. Anterior legs light brown; base of coxa dark brown; femora armed with an irregular comb of twelve semi-transparent flattened teeth; tibiae rather densely clothed with coarse hairs, armed with four dactyls, the posterior one weak; apical half of anterior margin lined with stout hairs; tarsi with basal segment not constricted. Median legs with tibiae stout, dark brown, with postero-lateral margin irregularly whitish, tarsi two-segmented, second segment (as in *T. lautilus*) capable of being bent into position of repose. Posterior legs with femora brown; tibiae pale brown, with upper margins armed with seven serrations (three external and four internal), with seven lamellae (four external and three internal) and with two pairs of distal spines; the sub-apical ones moderate, the inner marginal one distinctly the longer, one-half as long as inner apical one, apical spines long, armed near apex with three or four regular stout hairs; metatarsus greatly elongated, one-fourth longer than inner marginal subapical spine, the anterior margin strongly serrated, the posterior margin lined with closely set hairs. Length, 4.4 mm.; of pronotum, 0.8 mm.; breadth of pronotum, 1.0 mm.; length of elytra, 1.7 mm.; of posterior femora, 2.2 mm.

Loc. Queensland: Normanton, Gulf of Carpentaria district (R. Kemp). Type, unique, J. 14938, in South Australian Museum.

Allied to *T. lautilus*, from which it differs in the more numerous serrations of posterior tibiae and in the enlarged metatarsus. The tympanum at the base of the abdomen is not quite as large as in *T. lautilus*, and the strigil on the elytra is longer but composed of weaker teeth.

TRIDACTYLUS AUSTRALICUS Mjöberg.

Tridactylus australicus Mjöberg, Ent. Tidskr., 1913, p. 31; Chopard, Ark. f. Zool., 18A, No. 6, 1925, p. 6.

The description of this species is short. The antennae are said to have the first seven segments of the same length, the eighth a little longer, the ninth still longer, and the terminal segment the longest. The posterior legs are said to have only two obtuse teeth or serrations anteriorly from the lamellae, and the

metatarsi are longer than the "upper spurs." The length is 5 mm., and the wings are fully developed.

Loc. North-west Australia: Kimberley (types). Queensland: Cape York (according to Chopard).

The description does not agree with any one of the three Australian species before me. In particular the proportions of the antennae are different and the numbers of serrations on the posterior tibiae are less. In *T. tantillus* the metatarsus is just as long as the superior apical spurs, and in *T. musicus* there are three external and three internal serrations instead of two, as in *T. australicus*.